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[OFFICIAL NOTICE.]

Twenty-eighth Annual Meeting, New England Association of Gas Engineers.

OFFICE OF THE SECRETARY, LYNN, MASS., Jan. 20, 1898.

The twenty-eighth annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, Wednesday and Thursday, February 16 and 17, 1898.

C. F. PRICHARD, Secretary.

[OFFICIAL NOTICE.]

Fifth Annual Meeting, Michigan Gas Association.

OFFICE OF THE SECRETARY, SAGINAW, E. S., MICH., Jan. 11, 1898.

To the Members of the Michigan Gas Association: Gentlemen—You are hereby reminded that the fifth annual meeting of our Association will be held on Wednesday, the 16th, and Thursday, the 17th, days of February next, at Port Huron, Mich.

The new Hotel Harrington has been selected as Association headquarters, with rates, for all rooms without bath, at $2.50 per day; with bath, at $3 per day. From experience at our recent meetings it would be well to have rooms reserved as early as possible.

The following papers will be presented for consideration:

"Experiments with the Welsbach Lamp," by Mr. Frank H. Hess.

"An Automatic Closed Purifier," by Mr. Henry G. Beatley.

"Our Patrons: How to Treat Them," by Mr. S. Milo Dole.

"The Utilization of Coal Tar by Distillation," by Mr. Edward J. Ellis.

"Reminiscences," by Mr. Robert Calhoun.

Mr. Fred. J. Howden will also present a paper, the title of which is not received. Respectfully yours, HENRY H. HYDE, Secretary.

BRIEFLY TOLD.

OBITUARY NOTE, MR. GEORGE D. CABOT.—A week ago we had to report the death of Mr. George D. Cabot, whose useful life came to an end at his home, in Lawrence, Mass., on the morning of the 18th inst. Preferring that our account of his united history should be accurate rather than hysterical, the story of his life was put over for a week; and here we give its details, so far as fair collection may go. In relation to our story we wish to acknowledge our indebtedness to Mr. Chas. F. Prichard, of Lynn, Mass., and to Mr. C. J. R. Humphreys, of the Lawrence Gas Company.

Mr. George D. Cabot, whose kindly ways and thorough means were much better known to the gas makers of 1878 than to those of 1898, was born in Jamaica Plain, Mass., April 26, 1812. His first tuition was gained in the school conducted by Dr. John Homer, and his education was completed in the Watertown (Mass.) Academy. His first business employment was with the Boston drygoods firm of Merrick, Lea & Co., who were engaged in the earliest development of the production of cloths from cotton. In this line of trade he remained, in varying ca-

pacities and at different places, until 1845, when he removed to Lawrence, Mass., there and then assuming an important position with the mills and administration of the Essex Company. About 1850 (the natural drift of his mind put him rather in touch with the mechanical than the administrative division of any enterprise with which he was connected) he took charge of the machine shops of the Essex Company, out of which the Lawrence Gas Company subsequently grew. When the Essex Mills gas works had commenced to supply gas to the residents of Lawrence (about 1851) on a scale worth mentioning, Mr. Cabot was put in charge of that section of the Essex Company's business; and the best part of its trade, before or since, never was better in a monetary sense than was its gas trade. In his later years (always a man who kept his word and respected his obligations) Mr. Cabot, as Agent of the present Lawrence Gas Company, led that development of the Essex Mills Company's commerce, until he was succeeded in its management (1885) by Mr. C. J. R. Humphreys. In the year last named the veteran retired to enjoy the relief that his long period of faithful service with the Essex Mills and the Lawrence Gas Company justly entitled him; and it is our satisfaction to record here that none may say he was other than a man—just, and fair, and charitable.

He was present at the organization meeting of the New England Association of Gas Engineers, was a member of its first Board of Directors, and presided over its deliberations during the years 1875-76. Later on the Association signified its esteem of him, on his retirement from the active ranks, by naming him to the Honorary Membership list, which means much in the practice of the New England Asssociation. He was the first President of the Guild of Gas Managers, which place he held from March, 1880, to March, 1882. The Guild, true to its tradition of putting honor on those who should be honored, translated him to Honorary Membership, November, 1890. He was elected to non-resident membership in the Society of Gas Lighting, April, 1880; and his membership in the American Gas Light Association dates from his election thereto, May 13, 1874. In all of these bodies, representative of the engineering end of the gas industry, he was respected and liked. He left a son (Doctor John Cabot, of this city) and a daughter—Mrs. Stevens, of Chicago. The funeral services were held in his home at Lawrence, Mass., on the morning of the 21st inst., the Rev. George H. Young, of the Lawrence Unitarian Church, officiating. The gas industry of New England was represented at the services by Messrs. A. B. Slater, H. B. Leach, C. F. Prichard, Odiorne Swain, C. J. R. Humphreys, F. W. Thomas, C. W. Hinman and H. A. Allyn. The Guild of Gas Managers sent a beautiful floral token in remembrance of their ex-President, and the prayer at the grave was so harmoniously rendered and echoed that none there could doubt that a well loved man had been put to rest. A feature of the proceedings was in the fact that the pall bearers were seven of his stalwart grandsons.

NOTES.—Mr. Jacob G. Miner, of this city, whom many in the gas trade will remember as a manufacturer of gas lamp lanterns, died at his home, 611 East 139th street, on the 19th inst.——At the annual meeting of the Niagara Falls (N.Y.) Gas Light Company the officers chosen were: Directors, H. L. Brewster, E. Perkins, H. Hawks, G. N. Perkins, J. E. Pumpelly, P. A. Porter and L. A. Boore; President, H. L. Brewster; Vice-President, P. A. Porter; Treasurer, E. Perkins; Secretary and General Manager, L. A. Boore. This Company is prospering, as it should. And it is our further belief that Niagara Falls as a place for the utilization of power is quite up to all the possibilities that may be gained by transmitting power to Buffalo "some 20 miles away."——The Trustees of the Northern Liberties Gas Company, of Philadelphia, Pa., have announced that, during the current year, the dollar rate shall obtain in all the districts supplied by them—a concession of 25 cents per 1,000. The rate is named to become operative, in the respective districts, as follows: First district, Feb. 1; second district, March 1; third district, April 1.——Mr. Martin Molony, who has been in charge of the works' end of the Delaware County Gas Company, of Chester, Pa., since 1892, resigned that position on the 22d inst., to accept a responsible place with the United Gas Improvement Company, presumably in connection with the latter's operation of the Philadelphia gas works. Mr. John M. Callanan, who has acted as Manager of the Delaware Company for some time, will also assume the responsibilities of its engineering direction.——At the annual meeting of the stockholders in the Consumers Gas Company, of Wilkes-Barre, Pa., the officers chosen were: Directors, Abram Nesbitt, E. W. Mulligan, Ed. C. Jones, Jesse T. Morgan, Liddon Flick, R. J. Flick and John Flanagan; President, Abram Nesbitt; Vice-President, Edward C. Jones; Treasurer, Jesse T. Morgan; Secretary, John Flanagan.

[Prepared for the JOURNAL.]

Heat Developed During Purification.

By MR. J. P. GILL.

The excellent article of Mr. Herman Poole, in the JOURNAL of the 3d inst., on "The Heat of Revivification," has suggested the communication of a mode of viewing and treating the subject, which has long been familiar in its outlines to gas engineers, and which from its simplicity is, perhaps, of a more easily applied and practical character.

Omitting the minor impurities in the gas, such as bisulphide of carbon, which are important as obnoxious elements, but not so much so in this connection, it is assumed that the impurity to be removed is sulphureted hydrogen (H_2S), that the purifying agent is the sesquioxide of iron (Fe_2O_3), and that the result or product is sulphide of iron (FeS.) What will be the temperatures caused by the chemical reactions of the mass in the purifier and when removed therefrom? It is also assumed that the quantity of sulphureted hydrogen in the unpurified gas is 8 cubic feet per 1,000. As 1,000 cubic feet of sulphureted hydrogen weigh 94.8 pounds, 8 cubic feet weigh .7584 pound.

(A) The formula of sulphureted hyrdogen is H_2S.
The atomic weights are ..... 2 + 32 = 34.
Numerical weights ..... = .0446 + .7138 = .7584.

Therefore, there is .7138 pound of sulphur in the .7584 pound of H_2S. This quantity of sulphur will be employed in the following equation:

(B) The formula of sulphide of iron is..... FeS.
The atomic weights are ..... 56 + 32 = 88.
Numerical weights..... = 1.2492 + .7138 = 1.9630.

Therefore, the .7138 pound of sulphur combines with 1.2492 pounds of iron to make iron sulphide. This 1.2492 pounds of iron is employed in the equation below:

(C) The formula of sesquioxide of iron is.. Fe_2O_3.
The atomic weights are..... 112 + 48 = 160
Numerical weights..... = 1.2492 + .5354 = 1.7846.

Therefore, the 1.2492 pounds of iron requires .5354 pound of oxygen to saturate it, and the .7584 pound of the sulphureted hydrogen requires 1.7846 pound of sesquioxide of iron for its withdrawal from the unpurified gas.

The .0446 pound of hydrogen in the sulphureted hydrogen, as per formula (A), combines with the .5354 pound of oxygen set free from the sesquioxide of iron with the following result:

(D) The formula of water is.... H_2O.
The atomic weights are.... 2 + 16 = 18.
Numerical weights..... = .0446 + .3568 = .4014 pound of water, leaving .5354 — .3568 = .1786 pound of oxygen uncombined, and it may be so considered.

We have, therefore, as the product of the reactions in the mass of purifying material:

FeS.....	1.9630	pounds.
O.....	.1786	"
Wood	.7648	"
Water.....	.4014	"
Total.....	3.3078	"

To these are to be added the 1,000 cubic feet of gas, weighing 40 pounds, which passes through the purifiers.

The sum of the products of the above weights of the respective substances, engaged in the purification of the gas, multiplied by their specific heats, will be the amount to be divided into the heat units, 1141, of the combination of the iron with the sulphur to obtain the temperature in the purifier.

FeS.....	1.9630	pounds	×	.122	specific heat	=	.240
Oxygen	.1786	"	×	.2175	"	=	.039
Wood	.7648	"	×	.300	"	=	.230
Water.....	.4014	"	×	1.0	"	=	.401
Illuminating gas	40.00	"	×	.6022	"	=	24.09
Total.....							25.000

1,141° ÷ 25 = 45° temperature.

Add to these 45° the 32° of the Fahrenheit thermometer, between 32° and zero, and the temperature will be 77° by the thermometer. This is so near the daily experience in gas works as to prove the substantial accuracy of the estimate.

It will be noticed that the full heat units of the combination of the iron and sulphur are used in this last calculation. There are some who proportion the heat units to the quantity of iron used. This is

manifestly incorrect, for heat units are a constant and unvarying number for each and every substance being consumed or undergoing chemical combination. It cannot be divided, as the following examples will prove:

The heat evolved by 1 pound of hydrogen burning with oxygen is sufficient to raise the temperature of 62,030 pounds of water 1° F., or 1 pound of water 62,030, that is, 62,030 heat units.

One pound of carbon burning with oxygen produces heat sufficient to raise the temperature of 14,400 pounds of water 1°, or 1 pound of water 14,400°, the heat units of carbon. There are, therefore, 1 pound of hydrogen and 1 pound of carbon with 1 pound of water or 1 pound of hydrogen or carbon and 1° of temperature, from which, chemically speaking, there can be no deviation.

Also, 1 gramme of hydrogen will raise 1 gramme of water 34,462 heat units C., which is equal to 62,030 heat units F.; and 1 gramme of carbon will raise 1 gramme of water 8,000 heat units C., which is equal to 14,400 heat units F.; both of which are the same as the preceding.

Therefore, if 1 pound of iron combining with sulphur will raise 1 pound of water 1,141° F., the heat units, .5 pound of iron combining with sulphur will raise .5 pound of water 1,141°. If 1 pound of carbon uniting with oxygen will raise 1 pound of water 14,400°, .5 pound of carbon uniting with oxygen will raise .5 pound of water 14,400°.

The temperature obtained above, 77° F., shows conclusively that there is no danger of the ignition of the mass in the purifiers, under ordinary and normal conditions. The occurrence of any such risk would arise from a much larger quantity of sulphur in the gas than the normal average, and from the gas entering into the purifiers with an excess of temperature, or should acquire it while passing through the purifying material; an event of which the percentage of risk would be exceedingly small.

If, however, under these contingencies air should, from any cause, obtain entrance into the purifiers, the ferrous sulphide which may have been formed would be reconverted into sesquioxide of iron, with an addition to the temperature and the elimination of the sulphur, which in its nascent state might form combinations, which in their turn might further increase the temperature to a degree that would ignite the sulphur as well as the dried shavings or sawdust.

In the second place, inquiry is to be made of the character of the reactions when the material is removed from the purifiers and spread on the floor or paving. The material as hereinbefore found consists of 1.963 pounds FeS, .1786 pound of oxygen and .7138 pound of wood, of a mean temperature not varying much from that of the atmosphere. The F. units of heat produced by the combination of iron with oxygen are 2,280. 1.963 pounds of FeS contain, as per formula (B), 1.2492 pounds of iron and .7138 pound of sulphur.

Now, the formula of the sesquioxide is Fe_2O_3.

The atomic weights are.....	112+48 = 160
Numerical weights.....	1.2492+.5354 = 1.7846

Therefore, 1.2492 pounds of iron combine with .5354 pound of oxygen, making 1.7846 pounds sesquioxide of iron. The products multiplied by their specific heats are as follows:

1.7846 pounds Fe_2O_3 × .20.....	.3569
.7138 pound of sulphur × .2026.....	.1446
.7648 pound of wood × .3.....	.2294
3.2632	.7309

2,880 ÷ .7309 = 3,940° F. temperature, as the result of the purification of 1,000 cubic feet of the gas. This temperature would soon ignite the whole mass if it were not for its contact with air circulating freely. The specific heat of air is .2377.

Suppose that the 3.2632 pounds of the products be spread over 4 square feet, and that .5 cubic feet of air (in excess of that required for the chemical combination) passes over or rises therefrom per minute, which is a fair estimate. Let it require, say, 10 hours to effect the conversion of the FeS into the Fe_2O_3. Since the combination of the iron and oxygen is gradual, the development of the temperature of 3,940° will be gradual, and the air will gradually absorb it during the 10 hours, as follows: .5 cubic feet of air per minute will in 10 hours or 600 minutes amount to 300 cubic feet, which, multiplied by its specific heat, .2377, gives 71° to be added to the .7309, making 71.7309 to be divided into the specific heat, 2,880. 2,880 ÷ 71.7309 = 40° temperature; a practical result. This example illustrates the process of revivification. The form of this calculation may be varied to suit circumstances.

Thus it appears that what at first sight seems to be an obscure subject and a difficult problem to solve, is readily solved by easy calculations based on the chemical formulas, and with satisfactory results.

Diverging somewhat from the main subject, it may be remarked that the knowledge of the first or elementary principles, and their practical applications, of any branch of knowledge (whether in chemistry, mathematics, geology, physics, metaphysics, etc.), will often enable the possessor thereof to solve difficult questions in a general and practical way, with sufficient accuracy and with valuable results. Such knowledge must, however, be genuine and of such intimacy as to be available at all times.

It is not always desirable or possible to treat arithmetically complicated practical operations with precise scientific minuteness. In theory and exact science such detailed accuracy is demanded, and without it would be in a measure valueless. But, a broad view, based on first principles and how they should be applied, will enable an intelligent man to overcome many difficulties which he may encounter, and to accomplish successfully the work he may be engaged on. This is perhaps only a phase of the adage that theory and practice should go hand in hand; this is so in this instance, if by theory is meant a practical knowledge of elementary and underlying principles.

In illustration, it may be worth while to refer to the way in which the formula for ascertaining the quantity of gas delivered through a pipe was eventually reached. It was known at one time that the quantity discharged was proportional to $d \sqrt[5]{\frac{h\,d}{s\,l}}$, that is, to the square of of the diameter multiplied by the square root of the quotient of the product of the pressure multiplied by the diameter and divided by the product of the specific gravity multiplied by the length. This knowledge was absolutely necessary before progress could be made, but it gave no information of the actual quantity of gas discharged. By experimenting on a large scale it was found that the term needed a constant multiplier 1350, or $\frac{1}{.0000006}$, whichever it may be. This produced a true solution of the question.

Again, it was known that the transverse strain on a beam or joist was proportional to $\frac{w\,l}{b\,d^2}$; that is, the product of the weight on the beam by the length divided by the product of the breadth by the square of the depth. This knowledge was imperative, but, at the same time, not of practical utility. Experiment determined the constant factor or term $\frac{2{,}000}{3}$, which being equal to $\frac{w\,l}{b\,d}$ gives the equation $W = 666.6\,\frac{b\,d^2}{l}$, the constant numerical factor giving real results for *wood*, its elasticity not being impaired for long periods of time. Other experiments give the constants for iron, etc.

Thus, as the original theoretical data enabled mathematicians to obtain constant numbers, which with the theoretical values gave them practical answers and the desired information; so in a similar manner those, in a useful degree familiar with them, can by the aid of the elementary principles be able to develop a way, under varying circumstances, to avoid mistakes and reach successful results.

Both Sides of the Ledger.

[Communicated by MR. NORTON H. HUMPHRYS, F.C.S., to the *Journal of Gas Lighting*.]

The ordinary acceptation of this term, as applied to any individual customer, is to place the sums he owes on the one side and the amounts paid on the other. But the ledger account with a customer may be regarded in a wider sense; on the one side we may place the sums received from him, and on the other the expenditure on his behalf. It is usual to talk about good and bad lines, profitable and unprofitable transactions, and so on; and these expressions assume that a balance of this kind has been struck. In some businesses this extended ledger account may be a very simple affair. Take, for example, the case of a commission agent who buys $500 worth of goods and sells them for $525. Where the profits are a fixed percentage, and the establishment charges trifling as compared with the actual turnover, the profit made on each customer can be readily ascertained. But the manufacture, storage, distribution and sale of gas involve so many items, that an accurate valuation of profit earned on each customer cannot be closely arrived at. Yet gas engineers are frequently called upon to make such valuations. Questions such as that of the prospective supply of gas to a large gas engine, the owner of which is undecided whether to make

his own gas or to get rid of the engine and use steam instead, are continually arising; and the engineer is asked to report if the circumstances of the case are such as to warrant a special rebate being offered in the hope of securing or retaining the customer. The position is somewhat similar to that of a contractor putting in a price for erecting a building complete, which will be considered in competition with others. The sharper the competition, the greater the necessity for accurate cost books. For his own guidance, the contractor prepares a ledger account in respect to each transaction. On the one side he puts the cash received, or in other words the contract price; and on the other, the expenditure for material, labor, etc. A balance should remain, showing the actual profit earned. In some respects the supply of gas may be called a contract, seeing that it is supplied under fixed conditions as to price, and any question as regards an individual consumer invariably takes the form of allowing a discount or rebate. Under ordinary circumstances, the company cannot put a premium on the regular rate.

The annual revenue account may be regarded as a concrete ledger account with the consumers as a body; and for purposes of comparison, it is usual to divide each item by the number of tons of coal carbonized, or by the quantity of gas made or sold, and so arrive at the *average* cost of the gas, or at the *average* working expenses and sale of products per ton of coal. Computations of this sort, however, do not alter the *concrete* character, and they cannot be applied, without a great deal of adjustment, to individual cases. The actual cost of each customer is a question far more complicated than a simple ratio according to the quantity of gas he consumes. It will be affected by the regularity or degree of variation in the rate at which it is taken, and especially by the intervals of inaction. This latter point is very prominent in connection with the supply of electricity; respecting which it has been said the cost of being "ready to supply" may be greater than that of actually supplying. When a consumer has the service pipe connected or laid on to his premises, the suppliers accept the responsibility of giving him a supply up to the full capacity of the pipe, at any time when he wants it, day or night, Sunday or week day. He has a place in the rental and meter books; he occupies a proportionate share of the meter inspectors', clerks' and collectors' time and attention, whether the actual business done is large or small. An underground railway signal box, a private house, a bank, or a place of worship may each use a similar quantity of gas—say, about 100,000 cubic feet per annum—but under very different circumstances. The first takes a regular supply, hour by hour, throughout the year, with no interval of inaction, at the rate of about 12 cubic feet per hour. The second takes a varying quantity, commencing at dusk and turning out about 11 P.M. each night, ranging from a minimum at midsummer to a maximum at Christmas, and having periods of inaction averaging something like 18 hours out of the 24, or 75 per cent. of the whole. The third uses no gas at all for 9 months out of the year, and during the remaining period takes a larger quantity at a rapid rate for an average of perhaps two hours a day; the period of inaction being about 98 per cent. The fourth uses no gas for three summer months, and at other times takes a large quantity once a week on Sunday evening. In practice, the gas company find themselves called upon to supply a large variety of customers, and a general leveling up takes place; leading to a fairly regular demand throughout the year according to the season. It gradually decreases during the first half of the year, and follows a corresponding increase during the second.

So far we have been considering the use of gas for lighting only. The matter becomes still further complicated when we take in gas fires, gas stoves and gas engines. But the acquisition of fresh lines is an advantage, as adding to the number of conditions of demand, and thus tending to increase the leveling up action. If the company were called upon to supply a district composed entirely of one class, great inconvenience would follow, except in the case of the underground signal box, as the maximum demand would be short and irregular. A district of banks would want absolutely no gas all the summer, or at night; and one of churches would want but little all the week. Gas could not be sold at anything like ordinary rates under such circumstances. But take a district of two classes, and the conditions are improved; with three, they are still better. The addition of each distinctive class of user further improves matters. Here we have one of the factors that have contributed to the steady reduction in the price of gas. The introduction of gas cooking stoves, or of any other new line, tends to the benefit of the whole district. So we have observed two points: Each consumer represents a certain fixed charge, whether he takes little or much gas; and the actual cost to the company may depend more upon the way in which he takes his supply than upon the actual quantity consumed. Working under a uniform rate, it is possible to make a large loss on one customer and an exorbitant profit on another; and a condition of things may exist resembling the assessments in a badly valued parish—some paying more than their fair share, and some less.

The sharper the competition to be encountered, the closer will be the attention paid to "both sides of the ledger." When it is proposed to cut in with existing traders, and to secure a share of business by underselling, the costs are valued to the fraction of a penny; but the gas industry, from its first inception, has been satisfied to deal with the spontaneous demands. In other lines, we hear of armies of "drummers" being employed, and of special advertising agents, and the selling department forms a conspicuous feature in the expenses. While they have been straining every nerve and applying a high degree of skill to extending their business and increasing their customers, many gas companies have never solicited a single consumer, and yet find the business continually increasing. It is interesting to speculate as to what the dimensions of the gas business would be to-day if travellers had been sent round to solicit business or make a general canvass of the district, and the thing had been actively pushed from the first. But some have been absolutely indifferent to new business, and a general disadvantage attendant upon such a favorable state of affairs is that the actual requirements of the customers are not studied, as they would be under more exciting circumstances. This has been further encouraged by the feeling of security that follows the possession of a Special Act. Beyond a general idea as to the desirability of selling gas at the lowest price consistent with a fair profit, the working expenses have not received anything like the amount of attention usual in other industries, in these days of cutting and competition. Further, we must remember that gas was a new thing. Water, and perhaps other natural products, had been distributed; but gas was the pioneer in artificial products, involving some cost in their preparation in the way of materials and labor, sent out by means of conduits from a central station. Electricity, steam, compressed air or water, etc., have been able to profit by the experience of gas companies; but when gas was first introduced, there was absolutely no experience to go upon. The system was new and untried, and consequently fallacious notions were accepted and gradually became established by custom into the position of proved axioms. Nothing could be proved for or against them then; but in the light of present experience it is possible to assess them at their proper value.

One of these was the doctrine of a uniform price. A less robust industry might have been throttled by such a restriction; but it appealed to English sentiments of fairness and justice, and found favor all round. Even at this day it does not want supporters. The representatives of the consumers have fought hard for this principle, in Parliament and elsewhere, and they imagined they were securing a decided victory and a substantial benefit for the public when it was agreed that the user of 100 cubic feet of gas a year should be charged exactly *pro ratâ* with the consumer of 100,000 cubic feet a week. People who promoted consumers' companies and called themselves "consumers'" directors, or "consumers'" managers, announced their adherence to the principle; and those who looked at it from a shareholder's point of view only thought it appeared feasible and fair and regarded it as a judicious concession to the public sentiment that would cost them nothing. So the uniform rate became a power in the land; and to this day there are those who talk about the injustice of differential prices. It is the more remarkable that the uniform rate should have been so labored as regards the gas industry, because it has attracted little attention in other lines. The scale of prices of electricity, in some instances, ranges from 14 cents to 3 cents per unit; and in the supply of heat or power, the tendency is towards differential rates. The plea of the "justice" of a uniform rate cannot be supported from the accounts, as it assumes that the actual cost of each customer varies *pro ratâ* with the quantity consumed. The claims of strict justice could only be satisfied by charging each customer, first with the actual outgoings on his behalf, and secondly with a proportion of the profit—*i. e.*, the amount required to pay interest and dividends. The charges, as we have seen, are affected by many conditions other than the quantity of gas actually consumed.

This has been partly recognized from time to time in an indistinct kind of way, and from motives that savored more of expediency than of principle. Departures from the uniform rate were made as a concession to the demands of customers, or from motives of policy, as a means of retaining existing business or of securing new lines. First, there was the claim of the large consumer, leading to the introduction of a sliding scale of discounts according to the quantity consumed. In gas, as in all other things, the large customer is able to talk the loudest, and

his claims secure recognition on account of his influence, rather than from a sense of their justice. It is felt, and quite correctly in the case of the supply of gas, that the withdrawal of his custom would affect all concerned, shareholders and consumers, and that some concession is desirable to avoid such a catastrophe. It is true that an investigation of the accounts shows that much may be said in support of the justice of such a rule; but the system of discounts according to quantity of gas consumed is not introduced voluntarily as a fairer way of doing business than the uniform rate, but simply as a concession to a demand. Then there is the practice of charging a higher price to outlying townships. This was also a matter of arrangement, more frequently based upon arbitrary figures than upon a careful valuation of the actual additional cost of distribution, etc., concerned. The question of day or summer consumption, and the possibility of offering special rates in the hope of securing it, unlike the other variations, were founded upon a direct examination of the accounts. The sellers were struck with the waste of productive power as represented by the extent of manufacturing and distributing capacity laying idle all the summer, or through the hours of daylight. They saw that the expense of maintaining a line of main was the same, whether it was used to its full capacity for 1, or 12, or 23 hours out of the 24; that the same argument applied to land, gasholders and most of the other items represented in the capital expenditure; and that the expense of booking and collecting an account of $25 was the same as for $1.25. Therefore the differential rate for stoves and engines came in. But the expectations were not fully realized, for in practice it is found that the gas cooking stove is used all the year round, and not in the summer only, and that gas engines are employed during the hours of darkness as well as by daylight. Yet the advantage of the new lines of business is found by the accounts to be so marked as to warrant important concessions with a view of obtaining or retaining the same.

Another fallacy of a similar kind is the popular idea respecting the charge for rent of meter. This, like the differential rate, has been resisted on all sides. The consumers' representatives have fought against it; and if successful, they have imagined that they have actually secured for each and every consumer a saving represented by the charge for meter rent. "Consumers'" managers have taken credit by introducing such a boon, and shareholders have consented to abolition of meter rents under the idea that they were actually granting a concession. The general view of the question appears to follow the line of thought taken up by the consumer who recently wrote to the *Times*. and said he did not object to pay his gas bill, but he did demur to pay the gas company's parish rates. This gentleman had simply been reminded of a truism—viz., that the consumers, and not the company, pay the rates. The rates are an item on the expenditure side of the revenue account, just like coal or labor; and the revenue account is, as already remarked, a concrete ledger account with the customers. The profit and loss account may be regarded as the ledger account with the shareholders; but this distinction is not observed in practice. The effect is that if the rate is increased, or if the company are put to legal expenses in defending their rights in the matter of assessment, the charge against the consumers is increased to a corresponding extent. The profit and loss account is not affected at all. So it is with the meter rents. Where these are charged, the amount received appears as a special item to the credit of the consumers, and as such it goes to reduce the expenditure. When the meter rent is abolished, the expenses of repair and maintenance, etc., remain as before. There is no alteration on the expenditure side. The only change is the merging of the income received for meter rents with that for gas. If it was possible to annihilate the costs, or to put them in the profit and loss account as a special charge on the amount set aside for payment of full dividends. then the consumers would be actually relieved. The consumers continue to pay for the maintenance and renewal of meters, but with this distinction—that the charge per consumer now becomes a charge per 1,000 cubic feet of gas. Assume, for the sake of argument, that it figures out at 1 cent per 1,000 cubic feet. Next take the case of two consumers, each furnished with a 5 light meter, for which they pay 50 cents per year rent. The meter rents are abolished, and the consumers fondly imagine that they have saved this 50 cents. But, as a matter of fact, they still pay the meter rent, only it is at the rate of 1 cent per 1,000 cubic feet of gas consumed, instead of 12 cents per quarter. The one may use only 2,000 cubic feet of gas in the course of the year, and he pays 2 cents per annum meter rent. The other, however, may burn 80,000 cubic feet, in which case he now has the privilege of paying 83 cents per year meter rent. The point is illustrated in a more exaggerated form by the prepayment system. An extra charge per 1,000 cubic feet is put on the gas to cover the cost of fittings, stove, meter, etc., with the effect that one consumer taking only 5,000 cubic feet per annum gets the same thing for (say) 93 cents, as his neighbor who takes 25,000 cubic feet per annum pays $4.65 for. This illustrates, in a more pointed manner than is possible under the usual regimen, the fact that, whereas with a charge per consumer there is a known sum to pay, with the charge per 1,000 cubic feet the actual payment is variable, and the large consumer has to pay more than the small. The abolishment of meter rents is not a step in the direction of justice as between one customer and another, but quite the other way. The fault of the meter rent is that it did not go far enough. It was necessarily kept down to bare cost, as otherwise the consumer would soon find out that it paid him best to buy his meter, or, as has actually been done, private firms would step in and supply meters on hire in competition with the gas company. There should be a fixed charge to each customer, according to the size of the service pipe, covering not only the cost of renewing and maintaining the meter, but also that of the service pipe, a *pro ratâ* proportion of the unaccounted-for gas, with office and establishment charges that are dependent upon the number of customers. By this means the small consumer would be made to pay his own footing (which he does not do under present arrangements), and the initial price of gas would be reduced. There would be a nearer approach to justice as between the consumers; and the cheaper price would assist the development and security of the business.

We have seen, then, that the revenue account of a gas company shows the aggregate ledger account with the consumers; and that *averages* per ton of coal carbonized, per 1,000 cubic feet of gas sold, and per consumer can readily be taken out, but that these averages are not necessarily applicable to any and every particular case. We can readily find out the exact sum received from any one customer; but the amount laid out on his behalf is by no means so definite. The manufacturing charges for coal, wages, purifying materials and repairs have a fairly intimate relation to the quantity of gas sold. Up to a certain limit, they are influenced by the magnitude of the operations. Large parcels of coal can be purchased at more favorable rates than small ones; purification is cheaper on the large than on the small scale, and the larger the rate of production the greater the margin for the introduction of generator furnaces, mechanical stokers, transporting machinery, and other devices for cheapening first cost. Given a works already established, and making 50,000,000 cubic feet of gas per annum, the cost of increasing the output to 100,000,000 will be less than double the present manufacturing charges. It has therefore been found that a judicious reduction in price has not injured the profits, but has increased them by fostering the demand—that a large reduction to users of gas engines or some other special line has not injured the other customers but, on the contrary, has benefited them by hastening the day when an all-round reduction in price can be made.

Sudden fluctuations in demand have a marked effect on the manufacturing charges, necessitating either forcing the retorts or maintaining a number of them under intermittent use, or perhaps calling for a larger proportion of storage capacity than would otherwise be necessary. It is also evident that the proportion between the maximum daily or weekly consumption, as compared with the total annual output, is an important factor. Yet approximately it may be said that the manufacturing charges are proportional to the quantity sent out, and that each consumer is chargeable with a share in accordance with the quantity of gas he burns. The distribution charges, however, have a very slight connection with the actual quantity consumed, but a closer one with the number of consumers and their average distance from the works. The plant must, of course, be capable of meeting the maximum demand; but granting this, such questions as the mileage of main and the number of services and meters are the ones that actually determine the distribution charges. In any case, there is what one may call an enormous waste of working capacity. Several lengths of pipe are practically idle from one year's end to the other. Of the majority, but few are employed to anything approaching their full capabilities for more than a comparatively few hours in the year. The main or service leading up to a church is idle all the week, and that to a factory may be doing nothing during the summer. What would be the effect, as regards the cost of distribution per 1,000 cubic feet of gas, if the mains and services were passing gas at their full capacity throughout the year? The cost of distribution would be insignificant. The fact that this item varies as between one consumer and another, has been recognized by the common practice of charging a higher price to outlying townships. It has already been observed that a proportion of the establishment charges will be affected more by the number of meters on the books than by the quantity of gas sold. The amount required to pay dividend, as well as some part of the establishment charges, turns

rather upon the amount of capital invested than on the extent of business done; and the proportion between capital invested and annual income, is influenced by the maximum demand at any one time. The plant must be equal to meeting the Christmas demand, even if no business at all is done in the summer.

Further, in assessing the cost of the consumer, regard must be had to his relation to the whole. Apart from the questions of periods of inaction, maximum supply, etc., which are influenced by his peculiar characteristics, there are other matters affecting his cost—such as his distance from other customers, and the time at which he takes his maximum supply. A customer half a mile away from his nearest neighbor stands on a very different footing, as regards distributing and establishment charges, from one situated in the midst of a closely inhabited district. It is possible that these charges may run so high as to render him an absolute loss to the concern, instead of a source of profit. If he takes his maximum supply just at Christmas, when the majority are also taking theirs, and has long periods of inaction during the light season, he practically takes a corner in the manufacturing and distributing plant for his own especial use, and is therefore rightly chargeable with the cost of maintaing the corner throughout the year. Or perhaps he may want his maximum at a time when no one else does, requiring a special pressure to be put on for him, which means an increase of distributing charges in the shape of more unaccounted-for gas. Summer consumption is a good thing. If a fair proportion of cooking stoves can be used—say, one to every four consumers—extra pressure can be put on; and there is a good margin left for profit. But if there is only one stove to every forty customers, it is possible that the result of putting on the extra pressure is a loss instead of a gain. This inter-dependence, however, is not so marked as compared with the characteristic features of each customer, as to constitute an argument in favor of uniform rates.

The disposition to generalize, as shown in the disposition to assume that the *average* cost is the real cost, is also evidenced in a tendency to accept the circumstances of one works as representing those of others. They may be, but are not necessarily so. A scheme of differential rates that fits perfectly to the circumstances of one company, may be unjust and inexpedient when applied to those of another. It is quite possible to use the results of previous experience in other places as a guide, and they may prove a valuable assistance; but they must be applied with judgment and consideration, having due regard to special local circumstances. The object in view is not only to develop and retain a connection, but also to improve and consolidate the affairs; and special steps may sometimes be both just and expedient to this end, that would not be applicable in a general way. When a marked departure is made from the general custom, there is a disposition to condemn it as unjust or wrong, without taking the pains to inquire particularly as to its merits or otherwise. But it may prove an advance and not a retrograde step.

The electric light companies, with the benefit of past experience gained by gas undertakings in view, do not attempt to do business on an unrestricted uniform rate system. In fact they could not do so. The ratio between capital expended and income from sale of gas is usually less than 4 to 1. As applied to electric light companies, the ratio is at least double; and there are concerns actually earning over 50 per cent. profit on their sales, but yet unable to pay more than a very small dividend. Referring to regulations for the supply of electricity, there is usually a minimum charge, a limited maximum consumption, and a differential rate. An attempt to follow these lines on the part of gas companies would no doubt be received with a howl by the public, who in this, as well as in other ways, have freely given to electricity a privilege that would be denied to gas. A combination of the differential rate with the maximum consumption, known as the "Brighton system," is finding increasing favor with electricians. It involves, in addition to the meter, an instrument for recording the maximum rate of consumption. The quantity consumed as shown by the meter, is debited first with an agreed quantity—say, one hour's maximum consumption daily, charged at the full price of 14 cents per unit—and the remainder is charged at a very low price, perhaps 3 cents per unit. A premium is thus put upon extravagant consumption, and the regular user gets his supply at a price trending towards the lower figure. The sellers, on the one hand, are able to make a prominent feature of the low rate, to their own advantage. The minimum charge, which is usually fixed at the price of 20 units, which the consumer has to pay if he only takes one unit, is a recognition of the existence of a fixed cost per customer apart from his actual consumption. The limited maximum consumption recognizes the importance of that factor in the consumers' ledger account. Possibly a cynic may urge that the alteration is introduced more from motives of expediency than from a desire to do absolute justice; but this has no bearing on the soundness or otherwise of the arguments advanced.

The existing arrangement may answer so long as gas undertakings are able to continue their present course of steady increase and development, free from really serious competition. But if their rivals should succeed in altering this state of things, and the demand for gas should decrease, the restrictions of an unlimited uniform rate, whether with or without the slight assistance of a small charge per customer in the form of meter rent, would become a heavy burden. It should especially be remembered that competitors now enjoying limitations and differential rates are able to strike at the most profitable lines of their business, thus injuring them to an extent greater than that indicated by the actual loss of custom. Apart from this, however, I venture to think that the minimum and maximum restrictions and the differential rate present a nearer approach to absolute justice than the unrestricted uniform charge.

The Relations Between the Customer, Consulting Engineer and the Electrical Manufacturer.

[A paper read by MR. S. DANA GREENE, before the New York Electrical Society.]

The subject which I have chosen for this paper is an eminently practical one, and I shall endeavor in my remarks to call attention to certain causes of friction which at present exist between the parties in interest, and to suggest certain remedies which may serve to bring about a better understanding and to lessen this friction, which is, in my opinion entirely unnecessary.

In order to discuss intelligently present conditions it is advisable to trace briefly the development of the electrical business, and to do this one need hardly go back more than a dozen years. At that time electric lighting was still an experiment (from the commercial standpoint), electric railroading had not begun, and electric power transmission was discussed as one of the possibilities of the future. Very few of our institutions of learning had established separate electrical courses, and such a thing as a consulting electrical engineer hardly existed in this country. The few men who had some theoretical knowledge were eagerly caught up by the manufacturing companies, who had difficulty to find men capable of solving the many pressing practical problems with which they were confronted when they began to sell electric machinery. Thus the development of a practical generator and incandescent lamp immediately created a demand for suitable conductors and materials for outside and inside wiring, safety devices, etc., as well as close regulating engines, proper station appliances and many other things which are to-day regarded as "standards" in the business. It was less than a dozen years ago that the first fireproof switchboard was installed, in the Broadway Theater, New York. The specifications were drawn by a consulting engineer—a naval officer, by the way—calling for a fireproof structure, and the manufacturer no doubt accepted the order thinking that he could use what had always been used before, viz., a wooden framework. In this he was mistaken, however, and after a year's wrangling a slate board was installed, much to the manufacturer's disgust and at great expense to him. It is hardly necessary to say that this form of switchboard became standard immediately, and several years after, the manufacturer happening to meet the naval officer, said to him: "Someone was a d—d fool about that switchboard, and *you* were not the man." I well remember when I left the Navy to join the Sprague Company in June, 1887, I found that the technical force of the company consisted of Mr. Sprague, an ex-naval officer, and Lieut. Crosby, who had just left the Army. Upon explaining to the former how modest was my store of knowledge on the subject of "electric street railways," he at once assured me by saying that we were all in about the same boat and that there was a fine opportunity to learn. My opportunity came sooner than I expected when, about July 1, I was charged with the execution of a contract for the equipment of a 40-car road in Richmond, Va., which, under the terms of the contract, was to be in full and complete operation on the first of the following October.

Doubtless most of those present to-night can recall the remarkable growth of electric lighting and railway work during the next five years from 1887 to 1892, a growth that can fairly be called tropical. Plants sprang up in nearly every city and town in the country, and manufacturers sprang up with equal rapidity. There seemed to be unlimited money ready to invest in elecrical enterprises, and the anticipated profits were such as to make the old established manufacturing industries seem very poor investments. During this period, which may

be called the "forced expansion period," purchasers usually had to take what they could get, and consulting engineers were few and far between. Specifications for apparatus or installations, when there were any, were generally prepared by the manufacturer, and the purchaser rarely knew whether they had been fulfilled or not. By the close of this period, however, the colleges and technical schools began to turn out men who had taken special courses in electricity and who naturally looked for a chance to make an honest living. The first great demand of the manufacturing companies for technical assistants having been satisfied, many of these young men found their way into local operating companies, or else established themselves as consulting or contracting engineers, in which positions they found plenty of work; for by this time the imperfections in the earlier installations and types of apparatus had become plainly evident to the purchaser as well as to the manufacturer, and there was a general demand for better workmanship and more rigid requirements in installation. It may be here noted that much of the "anticipated profit" of the business, both of the operating and manufacturing companies, was spent subseqently in making good these early defects; and while the business as a whole profited largely by this reconstruction process, it naturally dampened the enthusiasm of the early investors.

In 1895 came the panic, and for the past four years there has been a wonderful record of savings and economies both in electrical manufacturing and operating companies, as well as a great improvement in quality of product. It has been, in fact, the "economic and reconstruction period." The operating companies have learned that they too are manufacturers of a product, electricity; and as these hard times have forced down the price of their product, they, like the manufac turers of apparatus, have had to keep their heads above water and their companies out of receivers' hands by the introduction of more economical and improved methods of manufacture and of administration. During the past year tnere has been a marked improvement in the elec trical business; is is to be hoped that this improvement is permanent, and that the past four years of retrenchment and economy have paved the way for a normal and steady growth on conservative lines—in other words, for a period of "natural expansion." The business to day is on much the same basis as in other industries where prices are close, competition keen, and where a better article is furnished for less money than ever before.

The manufacturers of apparatus and the manufacturers of current are dependent upon each other to a large extent and their relations should be close and friendly. The consulting engineer, as in other engineering trades, is a necessary and proper connecting link between the two, and I can say frankly that I believe he has a proper and permanent field of usefulness. Broadly speaking, his function is to see that his client who buys apparatus and installs it selects first that sys tem best suited to his particular local conditions, and then, in purchasing, secures the best (not necessarily the *most*) for his money. It is equally the duty of the consulting engineer to learn what the manufacturer can reasonably be called upon to make, to consult with him freely and to obtain the benefit of his experience; to give him credit for work well done and to insist that bad work shall be promptly corrected. Many consulting engineers, especially those who have recently commenced practice, seem to think that it is improper for them to consult with the manufacturer, or to examine his plant, or to ask him for information or advice. Their idea seems to be that by so doing they may be accused of partiality or undue bias, or with lack of proper care for the interests of the purchaser; or they may feel that it is derogatory to their own dignity as engineers. The inevitable result is that specifications often contain provisions which are a sort of annoyance and expense to the manufacturer and purchaser alike, and which have no compensating advantages from either the engineering or commercial standpoint. In fact, some of these provisions are impossible or impracticable of fulfilment, and in such cases the honest manufacturer who wishes to meet the specifications and guarantees required finds himself forced to ask the engineer or the purchaser (sometimes both) to modify them. This is a proceeding which is always difficult and delicate to undertake, and often results in friction and trouble for all concerned. I am satisfied that if every consulting engineer would take advantage of opportunities as they occur to visit manufacturing establishments, see the work there in progress and confer with the engineers, he would find himself well repaid for the visit and his own work and practice benefited thereby. I am equally satisfied that no reputable manufacturing establishment would refuse admittance, but on the contrary, would welcome such visits as beneficial to both parties. The day of mysterious methods of manufacture, carried on behind closed doors, is passed in the electrical business, and I appeal with confidence for an endorsement of the opinions just expressed to those consulting engineers who have already tried the plan suggested. I have said that I thought the engineer would find himself repaid by such visits. I think also that he will find himself in a better position to advise his client intelligently. A purchaser usually knows little or nothing of the relative technical merits of apparatus, and his final decision is governed largely by price and by paper statements and guarantees, which may mean much or little. The consulting engineer who has seen the apparatus in process of manufacture can advise, not only as to whether the various bids comply with the specifications, but also what make or makes of apparatus are, from their design, construction and factory inspection and test, most likely to give the least trouble and expense in continuous service.

Some engineers seem to measure their value to the purchaser by the length of their specifications, and some of these formidable documents strike terror to the heart of a busy man confronted by a deskful of mail. The specifications not only specify what the conditions of service are, what apparatus is required, and what tests shall be applied to it for acceptance, all of which are quite proper, but also *how it shall be built*, which is another matter. The electrical manufacturers of this country, following the admirable precedent which has given American manufactured products (particularly machinery) a world-wide reputation, have endeavored to establish *standard* lines of apparatus whenever the permanency of type and the size of the demand warrant it. This practice tends not only to reduce cost (and with it price), but also enables the purchaser to secure quickly and at a minimum of expense, duplicate parts which are really duplicates, and which can be fitted without the aid of a skilled mechanic. It is the American system of standard lines of machinery and interchangeability of parts which has stood the test of time and which holds its own against all competitors. This system, however, is possible only where the same article is manufactured in quantity, since the expense of designs, drawings and patterns, special tools, jigs, dies, etc., is prohibitive unless spread over a large production. On the other hand, if special apparatus is required, it means a relatively large expense for these items which cannot be charged to a standard product, and which thus constitute a handicap both to the manufacturer and the purchaser. A machine is "standardized" only after long experience both in manufacture and service, and other manufacturers (the builders of engines, trucks, etc.), as well as the *users*, are invariably consulted before such standardization. It would appear to be to the interest of both seller and buyer to use such standard machines wherever and whenever possible; and yet it seems to be a fact that the demand for special machines is increasing rather than decreasing as apparatus becomes more generally standardized. To prove this I can cite the experience for the past year of one manufacturing company with which I am familiar. During this period the designing engineers were called upon for estimates on *special apparatus*, as follows:

Direct current: No. of estimates, 300; No. of KW. of apparatus involved, 31,000.

Alternating current: No. of estimates, 300; No. of KW. of apparatus involved, 131,200.

These estimates were all embodied in formal propositions; besides these there were between two and three times as many preliminary estimates required to answer inquiries of customers, which the engineers had to prepare.

This was in addition to their regular work on standard lines of apparatus, of which there are over 30. Some of this work was undoubtedly due to new developments in the business and to new methods and inventions, a condition which, although unfortunate from the manufacturing standpoint, must exist for many years to come; but a great deal of it was also due to the fact that specifications call for special apparatus, or methods of construction, where standard apparatus and methods would do equally well. This experience I find is common among electrical manufacturers, and I attribute it largely to lack of touch between the manufacturer and the engineer drawing the specifications, whether he be regularly employed by the purchaser or retained in an advisory capacity. Let the engineer see more of the manufacturer and his work, and let him hold the latter responsible for results as determined by proper tests, leaving the details of construction where they belong, in the manufacturer's hands.

This brings us to another phase of the subject, viz., the tests and guarantees prescribed by specifications. Omitting from consideration matters which, as already stated, belong properly to the designer and builder, such as current densities in the windings or in brushes, methods of insulation, kinds of material, etc., etc., the tests necessary to determine a machine's quality (and hence its value to the purchaser) are few in number and can be enumerated under the headings of

efficiency, *heating*, *regulation*, *sparking* and *insulation*. If the requirements under these five headings were formulated under some general rules, and if the methods of tests to determine results were uniform, the work of the consulting engineer and the manufacturer would be vastly lessened. Such unfortunately is not the case, and specifications on these points vary widely both as to requirement and as to the method of test. It seems practically impossible for the various manufacturers and consulting engineers to standardize these requirements and tests by any concerted action, and the only other solution of the difficulty is for some scientific, non partisan organization to undertake the work. The American Institute of Electrical Engineers is just such a body, and it would render a great service to the entire electrical business if it would consider the matter. Without attempting in any way to suggest what action it should take, it seems proper to call attention to some of the points which most frequently give rise to misunderstandings and disputes.

1.—*Efficiency.*—The proper distinction between electrical and commercial efficiency is not made. The latter is what interests the purchaser, and it should always be specified. A clear statement of what losses must be included to determine it, and also a general statement of what constitute reasonable and proper commercial efficiencies in well designed machines, would be of great service. Such a statement should show the necessary difference between carbon and copper brushes, and between the voltages most commonly used in direct current work, viz., 125, 250 and 500 volts, as well as between machines of various sizes. The formulation of such information on alternators is more difficult, but all manufacturers have certain standard lines of these machines and it is quite possible to make some intelligent general rules.

Electrical manufacturers are sometimes required to guarantee the *combined* efficiency of generator and engine (or other prime mover). This is clearly unfair and shifts the direct responsibility of guarantee from the maker of the prime mover, where it properly belongs.

2. *Heating.*—For all ordinary conditions of service, the safe heating limits for continuous full load operation can be determined with a fair degree of accuracy. The commutator heats more than any other part of the machine, particularly with carbon brushes, a fact which is often ignored. Sometimes the heating is measured by thermometer, sometimes by increase in resistance. There should be one uniform method followed. Overload guarantees (ranging from 25 per cent. to 100 per cent.) are sometimes required for a period within which the ultimate temperature of the machine is reached, and the necessary capacity of the machine is thus increased as certainly as though a larger machine were specified. It would seem that the time duration of overload tests should bear some relation to service conditions. If the service requires a 50 per cent. overload for eight hours or more, a larger machine is evidently necessary.

3. *Regulation.*—Specifications frequently call for a straight line compounding curve, a condition which is practically impossible until we discover a magnetic material which has a straight line saturation curve. Another common requirement in the case of lighting generators is that a drop of say 2 per cent. in speed shall not affect the electromotive force more than 2 volts, which is also an impossible condition even with a separately excited generator. A reasonable margin in either case, having due regard to the service for which the generator is intended, should always be allowed.

4. *Sparking.*—Modern design and the use of carbon brushes have greatly reduced the trouble from sparking, but machines are sometimes called upon to stand excessive overloads without sparking, which can be accomplished only by using a larger machine or by a distortion of design, which is bad practice. Any good machine with carbon brushes should be able to stand a variation from no load to full load without movement of brushes and without noticeable sparking; it should also stand a reasonable overload, say 25 per cent., without injurious sparking.

5. *Insulation.*—This is a cause of frequent trouble and annoyance. The common practice is to specify an insulation resistance of so many megohms, regardless of the size of the machine and the voltage and conditions of service. Considering the fact that this resistance varies inversely as the area of surface to be insulated, and considering the enormous variations in size, shape, voltage and service requirements of different machines, it is evident that such a test is impracticable and means little or nothing. Insulation resistance is largely a question of dryness, and if an armature be baked for a sufficient length of time almost any resistance within reason can be obtained. I have known a large 400-kw. lighting armature to measure a megohm resistance, as required by specifications, after several days' baking (which by the way permanently injures the structural strength of the insulating material), and yet it showed practically no resistance when it reached its destination, because it had been in the rain and dampness for a week or more and the large surface naturally afforded an excellent lodging place for moisture. A day's run in a weak field, with the armature short-circuited, quickly brought the insulation up again.

The only proper way to insure good insulation, with reference both to the material used and the method of construction employed, is by a *high potential* test applied when the machine is reasonably dry. This test should be intelligently gauged by the voltage of the machine and the service required. Thus a high potential test of 1,000 volts is ample to detect any insulation weakness in a 125-volt lighting generator, while a 5,000-volt test is ample for a 1,000-volt alternator, allowing proper factor of safety in each case. Recent careful investigations have developed the fact that the only correct way in which to determine the proper high potential test for any given machine is to consider jointly the time duration of test, the current frequency and the voltage of machine. As the latter rises, the margin between it and the test voltage necessarily decreases, on account of the liability to permanent injury of the insulation when subjected to excessive voltages. Because 5,000 volts is found to be a proper test voltage for a 1,000-volt machine, it by no means follows that 50,000 volts is proper for a 10,000-volt machine, or that the apparent factor of safety should be the same as the voltage rises. There should be a careful formulation of proper high potential tests for different classes of apparatus, based upon scientific investigation and tests, and it is believed that it would not be a matter of any great difficulty to formulate such a schedule.

It is earnestly to be hoped that the Institute will consider that these questions come properly within its sphere of action, and that it will take action in a matter of so much moment to all concerned. It should be remembered that where special conditions are imposed which lead to distortion of design or to the manufacture of special apparatus, the purchaser, no less than the manufacturer, is bound to suffer, and it is the purchaser who pays the bills, directly or indirectly. If the purchaser finds himself involved in unexpected expenditures, the consulting engineer, too, comes in for his share of blame and dissatisfaction.

We come finally to the commercial requirements which have gradually found their way into specifications, and which are sometimes onerous and unfair. Perhaps the most important of these is the question of shipments. It is not uncommon for shipment to be specified by a certain date, under a forfeiture of so many dollars a day for each day's delay thereafter, and the award of the contract is often largely affected by such promises. The manufacturer starts the work in his shops and if the time is short he is apt to work overtime. About the time the apparatus is ready for shipment, and without any previous warning, word comes to withhold shipment because the purchaser is not ready to receive it. There were recently 15 carloads of apparatus lying in the yards of one of our manufacturing establishments, besides a number of large machines stored in the shipping and testing departments, which had been made on time contracts and held at the last moment by request of the customer. It is difficult for one not in this end of the business to realize the resulting demoralization throughout the shops, and it is a condition which could easily be remedied by the exercise of more foresight on the part of the purchaser and his engineer. In all cases where a penalty for delay in shipment is imposed, it is fair and reasonable to ask that a similar bonus should be awarded if shipment is made in advance of promised date, or if the purchaser is unable, through no fault of the manufacturer, to receive the apparatus on that date. It is sometimes required that the consulting engineer shall have free access to the shops at all times while the apparatus is in production. Such permission is impracticable if proper shop administration and discipline are maintained, and these visits should be made at certain specified stages of the work. It is of course always proper for an engineer to be present when the apparatus is finally tested.

A clause is commonly found in specifications providing that the consulting engineer shall be sole judge of the true intent and meaning of the specifications; and in case of any dispute thereunder his decision shall be final and binding. It is true that this clause is common in architects' and builders' contracts, but it is doubtful whether it could be enforced at law in case of a dispute as to facts, and it certainly seems fair that in case of such a dispute, where the two parties honestly disagree, provision should be made for a third, disinterested party to act as arbiter.

While there are many contracts executed which involve one or more of the provisions (technical or commercial) mentioned above as liable to cause trouble, and where no trouble is experienced, due to the com-

mon sense and good judgment of both engineer and manufacturer, still the cases where trouble does arise are not infrequent, and the best specification is one so fair and so clear that no dispute or misunderstanding can arise except with malicious intent, and which requires no arbiter to interpret its true intent and meaning.

In conclusion, let us hope that the customer, the consulting engineer and the manufacturer will in the future consult each other more freely and frankly, by personal interview or by correspondence, and that all of them will unite in indorsing any intelligent attempt to standardize such tests and technical requirements of electrical apparatus as are matters of common usage in our daily business intercourse.

The Geology of the Jackson Shaft Coal.

[A paper read by MR. ANDREW ROY to the Ohio Institute of *Mining Engineers.*]

Two limestones, the gray and the blue, known in the later state geological reports as the Ferriferous and Lower Mercer, separated from each other by about 130 feet of strata, constitute well known geological horizons in the lower coal measures of southern Ohio. The gray limestone, which is the upper stratum of the two, is capped by a band of iron ore, which for more than half a century has been the mainspring of the charcoal iron industry of the Hanging Rock iron region on both sides of the Ohio river.

In Jackson county, in the townships of Miller, Lick, Coal and others, the horizon of the Wellston coal is due about 260 feet below the gray limestone, and about 130 feet below the blue. These seams of coal never rising to workable height are met between the two limestones and between the Wellston coal and the blue limestone. About midway also between the Wellston and Jackson coals a thin bed comes on the scale.

A vertical section from the gray limestone to the Jackson coal would be difficult if not impossible to obtain, as there is not only no known point in the strata in the Jackson field where the coal has been met directly beneath the limestone, but it is very doubtful if it exists beneath this limestone. There are, however, numerous vertical sections given in the geological reports of the intervals separating the gray and blue limestones, and the blue limestone and Wellston coal. A section between the Wellston and Jackson coal furnished further on places these coals 135 to 175 feet apart. From the gray lime to the Jackson coal these intervals, as I have measured them, are as follows:

From gray to blue limestone.....	130 feet.
From blue limestone to Wellston coal.....	130 "
From Wellston to Jackson coal.....135 to 175	"
Total.....	435 "

There is a play of variation of 20 feet from the Wellston coal to the blue limestone in some parts of the Wellston belt, and also some converging and diverging of the strata separating the two limestones, but they are generally very slight.

The distance which is here given as separating the Jackson and Wellston coals—135 to 175 feet—does not harmonize with the published sections of the State Geological Reports. In volume V., page 1010, Dr. Orton states the interval between these coals to be presumably 75 to 100 feet.

There are several shafts sunk to the Jackson coal within the corporate limits of Jackson, but more of them are opened on ground high enough to hold the Wellston coal. The hills both north and south of Jackson, however, are high enough, and the coal is met in place in these hills. On the McKitrick farm, three-fourths of a mile north of Jackson, the Wellston coal has been opened for many years. About the same distance south of Jackson, the Wellston is also opened on the McClung lands. A horizontal line, prolonged from the McKitrick to the McClung mine, strikes the dome of the Jackson Court House, 175 feet above the Jackson shaft coal, in the swamps, or lowest places in the mines. The levels were carefully made with engineers' levels, and there can be no question as to the intervals separating these coals at Jackson Court House—the only place in the country where a vertical section can be had at all.

An excellent section from the gray limestone to the probable horizon of the Jackson coal was furnished by a drill hole, cut with the diamond drill under my direction, a few years ago, in Milton township, on the Latrobe furnace lands. The hole was located about midway between the village of Berlin and the Latrobe furnace, and was commenced 70 feet below the gray limestone. It was sunk to a depth of 384 feet below the gray limestone, and 254 feet below the blue—the gray and the blue being exactly 130 feet apart. Alternating layers of sandstone, blue and gray shale, with an occasional deposit of fireclay, were met to a depth of 371 feet below the gray limestone. Here a layer of black shale 5 feet thick was encountered, which probably represented the horizon of the Jackson shaft coal. A few feet below the shale, the drill ran into the conglomerate rock, which contained very hard pebbles, where the hole was stopped. A thin vein of coal was met 70 feet below the blue limestone, which I regarded as too near that formation to represent the Wellston coal. The lowermost bed of fireclay was met 300 feet below the gray limestone under a stratum of dark shale, 8 feet in thickness.

If the five feet of black shale, met in the drill hole at a depth of 371 feet below the gray limestone, was on the horizon of the Jackson coal there would be a convergence of 64 feet from the swamps, and 24 feet from the hills of the Jackson Mines to the drill hole. The line of direction is on the line of strike of the strata, or nearly so, the distance is about 7 miles.

The Herron shaft at Jackson is the deepest of the series of mines opened in the shaft coal. In this shaft, which is 90 feet deep, there is a vein of coal 12 to 15 inches thick, 75 feet above the lower coal. This vein lies about midway between the Jackson and Wellston coals. None of the other Jackson shafts hold this middle vein, because it overshoots their tops. It may have been mistaken by the geologists, who find the Wellston and Jackson coals 75 to 100 feet apart, for the shaft coal.

The Jackson deposit of the shaft coal is the only known basin in Southern Ohio. It rests above water level a mile west of Jackson, extends into Liberty township until it overshoots the hills and is lost in air. It gradually grows thinner along its western line of outcrop, but improves in quality. Two miles east of Jackson it becomes too impure for commercial purposes. It is about 8 miles in length; its width has not so far been demonstrated, but is somewhere near 3 miles. Two miles north of Coalton, at the Glen Nell mines, there are two beds of coal met in the same hill, separated by 70 feet of strata. The upper seam is the Wellston coal, thinned down to 2 feet, along its western line of outcrop. The lower seam has been regarded by some as the Wellston coal, by others as the Jackson coal. It is neither. It is the equivalent of the 15-inch coal met in the Herron shaft of Jackson, 75 feet above the shaft coal, enlarged to 3 feet. It is of superior quality to the Jackson vein, but not equal to the Wellston, although it has been mined and sold as Wellston coal. It is sandwiched in a long and narrow basin of the conglomerate rock formed by erosion anterior to the accumulation of the carbonaceous matter which subsequently became the coal. The conglomerate rises to within 40 or 50 feet of the Wellston coal in this vicinity.

The trough in which the Jackson coal is found was formed by erosion before the dawn of the coal bedding epoch. The bottom of this basin had a very uneven surface, as is shown by the hollows and hills encountered in the mines, some of the hills rising to a height of 40 feet. Over this irregular surface, profuse and luxuriant vegetation took root and grew, consisting of various plants differing in size from small masses to stately trees, which year after year dropped their leaves and fruit and in time died themselves, to be replaced by new growth and decay until a mingled mass of vegetable tissue was formed like the pulpy mass of a modern peat bog, 40 to 60 feet in thickness. At length through the agency of subterranean forces the land slowly and gradually sank, and in the submergence the weight of the beds of sand and gravel which were washed over the coal marsh, compressed the peaty tissue into its present hard, compact condition. The gravel bed washed over the coal marsh now constitutes the conglomerate rash which we find overlying the coal.

The trough holding the Jackson coal seems to have been the only one formed in Southern Ohio. The coal of the Mahoning and Tuscarawas valleys of Ohio, and the Sharon coal of Pennsylvania, belong to the same horizon as the Jackson coal. In all of these districts the coal is met in troughs or swamps eroded in the upper surface of the Cuyahoga shale.

Seventy-five feet above the Jackson shaft coal a second coal marsh was formed which is represented in the 15-inch vein of the Huron shaft.

The Jackson coal has so far never been met perpendicularly below the Wellston vein, but there is good reason to believe that the vein extends up Horse creek to the McKitrick farm, and reaches out to the south on the Mabees road as far as the McClung lands, where at both of these points the Wellston coal is mined for the local supply of Jackson and the surrounding country. This would give the Jackson coal a breadth of 3 miles, which is about the breadth of the Wellston belt.

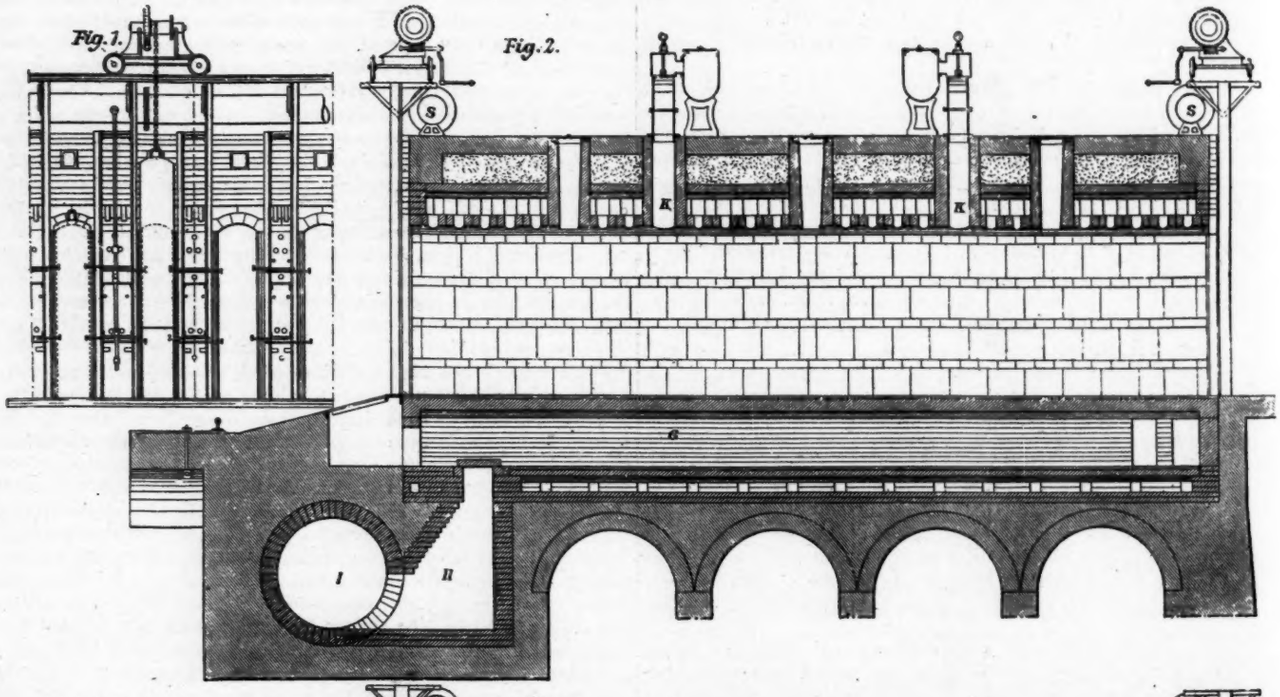
Outside of the Jackson and Wellston fields, at Hamden, at McArthur

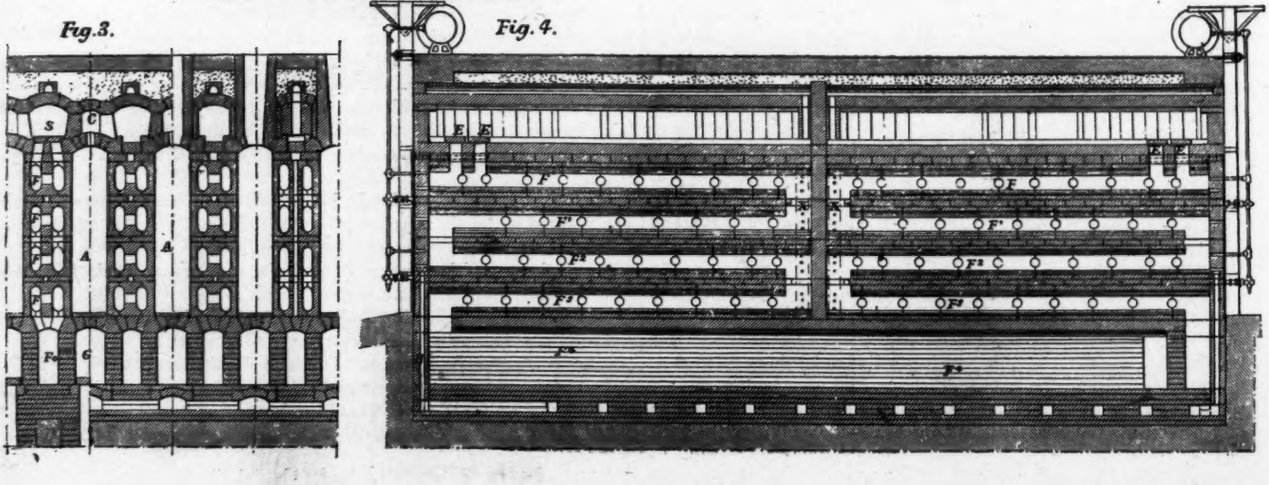
Junction, and at McArthur town and other points in Vinton county, the Cuyahoga shale is met 75 to 90 feet below the blue limestone and about 200 to 225 feet below the gray. A thin seam of coal, 4 to 12 ins. in thickness, is generally met on this horizon. Where it is absent it is on the ridges of the uneven Cuyahoga floor, which rises forming hills 15 to 20 feet in height, upon which the coal vegetation never grew. This is the representative of the Wellston coal, found in Washington township, in Jackson county and in Richland, Elk and adjoining townships in Vinton county. Wherever the coal is met in minable thickness, as at the Elco mines and the Vinton Furnace shaft, it is found fully 40 feet lower in troughs or basins carved out of the Cuyahoga shale as the Wellston basin was formed.

It was my intention in commencing this paper to include a description of the structure and area of the Wellston belt, but this would exceed the limits of this paper and weary the Institute. The Wellston coal will, however, form the subject of a subsequent article.

The Collin's Coke Oven.

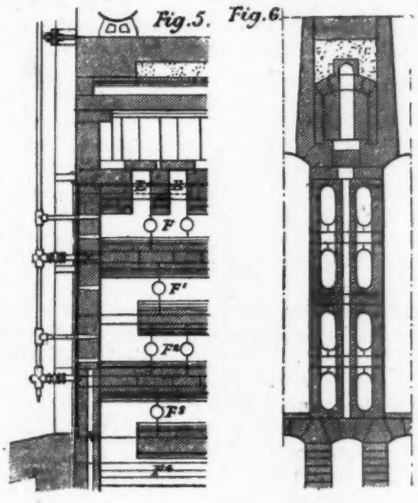
Engineering says that in the early days of the iron trade, when profits were large and foreign competition insignificant, the very large waste involved in the use of the old beehive oven for coking coal, or the still more extravagant method of coking in heaps, was a matter of perhaps secondary importance. Under modern conditions, however, the margin of profit has been so reduced that no firm, however well placed with respect to its supplies of raw material, can long afford to use old-fashioned plant or neglect any of the leakages, possibly small individually, but which in the aggregate may, unless carefully looked after, render the commercial success of the undertaking impossible. In some departments of industry it would not be extravagant to say that a modern works proprietor's living is made entirely from that which his predecessors would have wasted. In no industry were these wastes more excessive than in that of coke making. Mr. de Soldenhoff has estimated that in 1894 21,000,000 tons of coal were coked in the United Kingdom, and that with suitable appliances 400,000 tons of sulphate of ammonia and 900,000 tons of tar could have been recovered from the bye-products formed, the aggregate value of which, after deduction of working expenses, would have been 4¼ millions sterling. In addition to this it has further to be noted that in the operation of coking, the gases given off are of considerable heating power and are in the main wasted, as at most coking plants there is but a small field for their useful employment. The principal difficulty that has had to be faced and overcome in stopping the leakage here set forth, has been to combine the recovery of the bye-products with the production of good coke. There was obviously no advantage in saving the bye-products if the arrangements adopted to secure this end so interfered with the proper working of the oven as to render the coke non-uniform in quality or soft and friable. What the ironmaster needs is a strong coke, one capable of standing, without crushing, a high pressure in the blast furnace, as otherwise the loss occasioned there would far outweigh any possible saving effected by the sale of the ammonium sulphate recovered from the oven. It was on this rock that all the earlier attempts to work the profitable field of bye-product salvage came to grief; but





early failures are the foundations on which we erect our final successes, and later years have seen the production and adoption of many types of oven in which the bye-products are more or less completely recovered. Amongst the most recent of these is the Collin's oven, or rather ovens, for there are several types varied with the local peculiarities of the coal, devised by Mr. F. J. Collin, of Dortmund, Germany, and who has now opened an office at 1 East Parade, Leeds, England. These ovens, after an extensive trial on the Continent, have lately been erected here at the Syndale Collieries of Messrs. H. Briggs, Sons & Co., and by the Micklefield Coal and Lime Company, and another battery has been at work more than two years at the Ackton Hall Colliery in Featherstone, near Pontefract. One great advantage of the system which we are about to describe lies in the fact that the bye-product recovery plant is separate from the ovens proper, and can be added at any time without necessitating any alterations in them.

The horizontal type of oven is illustrated by Figs. 1 to 6. The front of the group of ovens is shown in Fig. 1, whilst Fig. 2 represents a longitudinal section through the oven proper, and Fig. 4 a similar section through the flues. In Fig. 3 a cross-section showing the arrangement of the flues on the side walls of the oven is shown, whilst in Fig. 5 we have an enlargement of the left-hand portion of Fig. 4, and in Fig. 6 a similar enlargement of the right hand flues in Fig. 3.



In addition to this type of oven, Mr. Collin has vertical and inclined ovens, but the horizontal type is that giving the highest temperature. This, indeed, exceeds the melting point of steel, so that the oven will carbonize any form of fuel. The time needed for coking is from 20 to 24 hours, and 7 charges per week can be relied on. The oven, which is 16 inches wide, takes a charge of 6½ tons of smudge, and yields a dense and homogeneous coke.

When the bye products are not being recovered, the oven is worked in the following manner: The gases given off from the coke leave the top of the chamber *A* through the openings *B* and enter the top flue *C*, where they are subdivided into several sections communicating with each other by the adjacent flue *D*, passing finally through damper *E*, down the sides of the oven through the flues F_1, F_2, F_3 and F_4, the latter of which leads to the bottom flue *G*. Thence they pass through the inclined opening *H* into the chimney, or they may, at will, be intercepted and be conveyed for use at steam boilers, or other similar purposes. In the case where the recovery of bye-products is to be accomplished, the slides *E* must be closed so as to stop the communication between the coke chamber *A* and the side flues *F*. Then the gases evolved from the coke ovens are exhausted from the ovens by means of suitable exhausters through receiving mains, which are shown at the top. Thence they pass to the bye-product plant to be treated by scrubbers, condensers and other special apparatus for the extraction of tar, ammonia, benzol, cyanates, etc. After these constituents have been extracted the gas is returned to the coke ovens through the pipes *S*, which lead the returning gas to the flues F^1, etc. By means of these pipes the gas is distributed by inlets specially adapted to utilize them in the flues of the side walls of the ovens. Together with the means described above for admitting and consuming the gases in the flues is a special arrangement for introducing a quantity of gas into the interior of the ovens, whereby a regular heat is secured. The gas thus admitted is combined with such portions of air as may be desirable for sustaining the temperature in the most efficient manner for effecting the thorough and rapid carbonization of the coal. By these means the process of coking may be sufficiently regulated through the whole length of the coke oven, and the thorough carbonization of the coal be thereby secured.

Besides the advantage of quick coking obtained in this way, the arrangement supplies the means of alternately admitting air into the flues as may be desirable according to the quality of the coal to be operated upon. These arrangements give the Collin's oven advantages over some other descriptions of coke ovens, and insure the production of a sound, good, strong homogeneous coke of superior quality. A considerable benefit will also result from the admission of air at suitable parts of the flues, so as to increase the heat when necessary. Special gas inlets are arranged by means of small pipes placed in a refractory cover in the side walls, and which terminate about the middle of the flues F^1 and F^3. Air with a slight admixture of gas may be admitted through the small pipes *O* or the air holes *X*. Leaving each end of the side walls at the beginning of the oven vaults, the air is conveyed to the proper points and distributed through small holes on the top of the side walls. The effect of this arrangement is important; it secures greater uniformity of heat and increases the durability of the oven. Another advantage resulting from these special means is that the tar is not consumed to nearly the same extent as in other kinds of ovens, where the side walls are superheated. By the means described the working of the ovens may be so regulated that high temperatures can be secured for the coking of the coal without involving the destruction of the valuable bye-products.

Requirements of the New York Board of Fire Underwriters for the Installation of Acetylene Gas Generators and for the Storage of a Limited Supply of Calcium Carbide.

The following rules anent the subjects named in the heading were adopted by the New York Board of Fire Underwriters on the 19th inst., and referred back to the Committee on Surveys for further consideration in conference with Special Committee of National Board of Fire Underwriters:

1. Plans and specifications in detail of acetylene gas generators must be submitted to this Board for approval, and a copy of the same placed on file in this office. If the plans are approved, a special examination of the generating apparatus will be made (at the expense of the applicant), and if it is found to be in compliance with the following requirements, a certificate of approval will be granted:

2. The generating apparatus must be located in an outside, fireproof and well ventilated building, where it will not be an exposure to any adjoining property.

The dimensions of the generator building must be confined to the requirements of the apparatus, and the limited supply (hereinafter mentioned) of surplus calcium carbide, which must be packed in watertight metal cans, and said buildings shall be located as follows:

For generators having a capacity of more than 25 pounds and not exceeding 100 pounds of calcium carbide, and, in addition, 100 pounds of surplus calcium carbide—not less than 10 feet from other buildings.

For generators having a capacity of over 100 pounds, and not exceeding 500 pounds of calcium carbide, and, in addition, not over 500 pounds of surplus calcium carbide—not less than 25 feet from other buildings, and these shall have the constant supervision of a competent person.

The storage of calcium carbide on premises, other than in generator building, is absolutely prohibited.

3. In constructing the building, dryness and ventilation must be secured. To meet these requirements, the floor must be raised above the grade on which the building is located, and suitable drainage provided. Ventilation is to be obtained by air passing from the outside of building through holes at the floor and through a pipe at least 6 inches in diameter, at the roof. The said pipe must extend at least 4 feet above the roof, and must be topped with a guard cap, and if there be any building within 10 feet of said pipe, then the ventilating pipe must be carried 4 feet above the roof of the higher building.

4. The maximum pressure of gas stored in a gasholder shall be limited to 8 inches of water, and both the generator and gasholder shall have water safety seals (not to exceed the same limit) in connection with escape pipes of not less than 1¼ inches in diameter. The escape pipes must be connected above the roof with the ventilating pipe of the building in which the generator is located.

5. A generator in which the gas is both generated and stored (the maximum pressure of which shall not exceed 5 pounds per square inch), and having no water seal, shall be tested to withstand a hydraulic pressure of 20 pounds per square inch. The generator shall have a pressure gauge, also a safety valve (not less than 1½ inches in diameter), adjusted to release the pressure of gas should it rise above the prescribed maximum limit. An escape pipe must be affixed to the safety valve and connected above the roof to the ventilating pipe of the building in which the generator is located. A certificate attesting the hydraulic test is to be placed on file in this office.

6. The pressure of the gas shall be regulated at the generator or gasholder, so that it will not exceed 4 inches of water on the pipes inside of the building to be lighted. A mercurial seal, set to that pressure, must be attached to the supply pipe at the generating building. A stop valve shall be placed on the supply pipe at the place where it enters the inside of the building to be lighted.

7. All generators and gasholders shall be connected by at least 1½-inch escape pipes and stop valves with the ventilating pipe above the roof of the building, through which the gas can be conveyed and discharged with safety on the outside of the building.

8. Generators must be constructed so that they can be charged with calcium carbide at all times without allowing the gas to escape into the building.

9. Generators shall be filled with calcium carbide by daylight only, and all generating apparatus must be in charge of persons who are familiar with their operation and are fully competent to manage them under all circumstances.

10. No artificial light, except a wire-guarded incandescent electric light, may be used inside of the building in which the gas is generated, and no heat except low pressure steam.

11. All acetylene gas generators and all receptacles containing acetylene gas shall be made of iron or steel throughout.

12. The residuum of the calcium carbide when removed from the generator must be deposited in a safe location outside of the building apart from any combustible material.

LIQUID ACETYLENE.

13. The storage of liquid acetylene in any building, or the use of liquid acetylene gas, is absolutely prohibited.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, Jan. 10th, 1898.

Refuse Destructors.—Stealing Gas.—Gas Engines for Generating Electricity.—The Preservation of Iron Structures.

Some attention has lately been directed to the utilization of refuse destructors as a means of raising steam, to be turned to profitable account for electric lighting, heating baths, laundry or other profitable purposes. Probably this is due to the fact that one of these appliances is claimed to be operating satisfactorily in London. But there is no getting away from the fact that ordinary dust-bin refuse is not inflammable. If it were, the scullery grate would be used as a destructor at once, thus avoiding expense of collection and risk of nuisance. No doubt a certain quantity of grease, cinders and other inflammable matter may be present, but not in sufficient quantity to evaporate the moisture, and, therefore, dust bin refuse, so far from being available as a source of heat for raising steam or any other purpose, requires the use of coal or other additional fuel to insure its "destruction." This was proved years ago, when somebody claimed that the waste grease, cinders, etc., from an ordinary household, contained in themselves the elements for furnishing a quantity of illuminating gas, amply sufficient to light up the premises brilliantly at night. Experiments showed that the cost of the preparatory desiccation of the refuse rendered it a more costly material than good gas coal. The financial success or otherwise of a public destructor must, therefore, turn upon the cost of the extra fuel. The rubbish must be got rid of, and in populous districts it may be a question of carrying several miles. So that the extra fuel may be cheaper than the carrier's van. Again, a large quantity of trade refuse, which is a different thing from household refuse, may be available. Bookbinders turn out paper cuttings by the cartload, cabinet makers and joiners accumulate large quantities of chips and sawdust, machinists have oily waste, and so on. Possibly they may be glad to get rid of this, not only without charge, but to pay for its removal. Under such circumstances the proprietors of the refuse destructor may get their excess fuel for less than nothing, and I suspect that, if the truth were told, this is the secret of the success that has been largely advertised. A cartload of dust-bin refuse, thrown into a large furnace with forced draught, etc., would not burn. But sandwich it between a load of sawdust and a load of dry paper cuttings, and the result would be different. But it would be a mistake to say that the household refuse provided the heat. There seems to be a curious anomaly in emptying the dust-bin of its useless contents gratis, and in making a charge for taking away sacks of sawdust or paper, which are really valuable fuels. So long as people are willing to pay, however, there is no fault in this. But somebody will find out, before long, that trade refuse available for destructors has an intrinsic value as a fuel or source of heat. The idea of utilizing trade refuse that is regarded as useless for the destruction of dust-bin refuse is ingenious, and one can easily understand why the latter should get the credit of furnishing the heat.

A case of stealing gas, proved before the magistrates at Newcastle a few days ago, is remarkable as being the means of exposing a novel method of swindling the gas company. It is a long time since there has been a case of hocussing the gas meter, though when this appliance was first introduced, when gas was three or four times as costly as at present, and when gas companies were less vigilant in respect to the amount of the quarterly account, such practices were not uncommon. Then they were mostly confined to the wet meter and usually took the form of perforating the drum by means of a pointed rat-tail file or other suitable tool, introduced through the outlet. This trick was checkmated by fixing a specially shaped guard or shield under the outlet, in such a way as to prevent direct operations upon the drum. After that, the dishonest customer preferred to disconnect the meter or to have a specially arranged bye-pass from inlet to outlet. He usually kept the key of the meter cupboard himself, and if the inspector happened to call before the meter and connections had been put in order ready for inspection, some excuse was made. The key had been mislaid, or the guileless customer was out and would not be back for an hour. But the consumer in question, whose ingenuity is certainly much greater than his sense of morality, thought that the perforation dodge might be applied to the dry meter, and accordingly bored a hole through the outer case, and then made a hole in the leather diaphragm by introducing a long pointed tool. This done, the hole in the outer case was carefully filled and soldered up flush, and concealed by a coat of paint. The suspicions of the inspector were soon aroused, whether by the unique practice of the customer painting the meter at his own expense, or by other suspicious circumstances, is not stated, but a special examination soon detected the fraud, with the result that the ingenious consumer finds that there is a heavy tax in the shape of a £5 fine on little experiments of this kind.

The company elected to take the more merciful course of proceeding under their Special Act, and simply charging the culprit with damaging the meter, rather than to give him in charge as an ordinary thief, under the common law, and to this leniency he is indebted for escaping the consequences of a criminal charge. This little incident shows that gas inspectors need to keep their wits about them, and exercise a great deal of caution and shrewdness, in cases which appear suspicious. And also that gas companies should have the right to enter the premises of a consumer at reasonable times, to count the number of burners in use, and obtain other evidence as to the actual consumption of gas. Although the law is rather vague on this point, it is generally understood that the right to inspect does not extend beyond the meter, an interpretation which places the company at the mercy of the consumer when any complaint arises.

The late Mr. Denny Lane, of Cork, had a great idea of the future of the gas engine in connection with electric light installations, and believed that electricity could be generated in a comparatively small station in the immediate vicinity, at a cheaper rate than it could be furnished from a central generating station at a distance. Or, in other words, that a moderately large user could supply himself with electricity at a cheaper rate than he could purchase it from a corporation or company. Mr. Lane went so far as to advise gas companies to take up the question of electricity supply by means of a comparatively large number of generating stations, say one in each street, using gas engines as a source of power. Unfortunately for the success of his plan, at that time gas engines were costly in the first place, and the running was not sufficiently steady. But great improvement in respect to both these matters has lately been evident.

I know of several small installations, using engines of 3-horse power to 14-horse power nominal, that have been running for years with satisfactory results to the owners. But it is difficult to get sufficient data, either as to the cost of the electricity per unit, or as to the actual lighting value obtained, to admit of a full comparative statement being prepared. So it is not possible to say accurately whether the gas en-

gine, dynamo and electric plant, is capable of developing a larger lighting value per cubic foot of gas used, than would be obtainable by the direct agency of incandescent burners. Allowing that 20 cubic feet of gas are used per horse power, and accepting the usual estimate that 1-horse power is sufficient to supply 10 nominal 16 candle power lamps, we get a duty of about 8 candles per cubic foot of gas, or less than half that claimed for the incandescent burner. So that unless there are other special advantages it would appear that the latter system is by far the cheaper. A decided advance has, however, been noticeable during the past year in the introduction of gas engines specially suited for generation of electricity. An installation of this kind at the Leicester railway station, belonging to the Midland Railway Company, includes six gas engines, four of 90 horse power each, and two of 50-horse power. And the cost of the electricity produced is said to compare favorably with that at other stations belonging to the company where steam engines are used. The great advantage of the gas engine for this purpose is the fact that it can be stopped and started instantaneously, without loss of time and expense in getting up steam, there is absolutely no working expense while it is lying idle, and the consumption of fuel is proportioned to the actual power used. In a recent issue of the *Engineer* there appeared an illustrated description of a 200-horse power gas engine.

In the same magazine the important question of the preservation of iron work has lately been discussed, and the conclusions arrived at are of special interest to those who are concerned with structures, like gas-holders, that are at one time exposed to air, and at another immersed in water.

The writer insists on the advantage of pure unadulterated linseed oil as a medium, and deprecates the use of turps or driers. Dealing with the question of the rusting of an iron surface beneath the paint, he refuses the common explanation that this is due to the entrance of air and moisture through minute cracks and fissures, occasioned by the different rates of expansion and contraction possessed by the iron and the paint under differences of temperature. Both raw and boiled linseed oil form, when dry, a sufficiently pliable skin to avoid cracking under any ordinary variations of temperature, and while fresh the film is both air and water tight. But it is also hygrometric and liable to swell by absorption of moisture, and under this condition becomes more or less porous, and allows both air and water to pass through by a process of diffusion. From this conclusion it appears there is no such thing as a permanent preservative of ironwork. That even under the most favorable circumstances, when a perfectly pure paint is laid on a well cleaned surface from which all rust and scale has been removed, there must be periodical inspection and repainting from time to time. It is a question of a pure oil and well ground pigment which must be inert in a chemical sense, and a well cleaned surface. There is nothing in the way of special preservative quality to be claimed for any pigment. The finer it is ground the greater the quantity that the oil will take up, while still retaining a proper degree of fluidity to work properly under the brush. And the larger the proportion of pigment carried, the greater will be the covering power and the resistance to swelling under moisture. This is simply coming back to principles that are well known to all who have had any experience in painting outdoor ironwork. Use good, unadulterated materials and avoid pigments that may set up chemical or galvanic action under the working conditions to which they are exposed. And the surface to be painted must be thoroughly freed from scale, rust and old paint, immediately before the new coat is applied. A common mistake is to clean off a whole structure first before laying on any paint. This may mean perhaps 8 or 10 days' exposure of the cleaned surface before the fresh coat is laid on, which is time enough for it to accumulate a new coat of rust or dirt. A good paint should dry flat, smooth and hard, and a second or third coat, with careful cleaning and drying between each application, is an advantage.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

DELEGATE QUAST, of Baltimore City, Md., has introduced a bill in the Maryland Legislature, the gist of which is that no corporation in Baltimore City shall charge more than 90 cents per 1,000 cubic feet for illuminating gas.

AT the annual meeting of the shareholders in the Delaware County Gas Company, of Chester, Pa., the officers chosen were: Directors, W. S. McManus, Richard Wetherill, Geo. B. Lindsay, O. B. Dickinson and Richmond L. Jones; President, W. S. McManus; Vice-President, Richard Wetherill; Secretary and Treasurer, L. A. Tucker.

ANDREW JENSEN and others are applicants for a franchise for the right to operate a gas plant at Great Falls, Mont.

THE plant of the Trenton (Mo.) Gas and Electric Company was recently sold at auction, under foreclosure. The property was purchased by Joseph S. Parker at his bid of $10,500. The deed of trust under which the proceeding was brought was to secure a mortgage of $9,000.

AT the annual meeting of the Pulaski Gas Light Company, of Little Rock, Ark., the officers elected were: C. M. Taylor, R. A. Little, J. G. Fletcher, J. A. Fones, C. F. Penzel, S. M. Apperson and Jas. T. Pullen; President, C. M. Taylor; Vice-President, R. A. Little; Secretary and Manager, J. T. Pullen; Treasurer, Oscar Davis.

THE Baldwin Gas Light Company has been incorporated in San Francisco, Cal., by Messrs. Marcus Stone, Charles L. Asher, Frank Pauson, Joseph Naphthaly, Samuel L. Naphthaly, A. E. Brooke Ridley and Chas. L. Ackerman. The initial capitalization is $100,000, of which $80,000 has been subscribed.

THE composition of the Committee on Electricity, Gas and Water Supply, of the Assembly of the New York Legislature, is as follows: Messrs. Goodsell (Chairman), of Orange; Taylor, of Oswego; E. L. Smith, of Herkimer; E. C. Brennan, of Kings; Kavanaugh, of Saratoga; Eldridge, of Warren; N. J. Miller, of Erie; Hatch, of Steuben; Fordyce, of Cayuga; McKeown, of Kings; Kelly, of Albany; Fritz, of New York; Sandford, of Westchester.

THE following letter is from Mr. W. A. Aldrich, Secretary of the Spokane Falls (Wash.) Gas Light Company, who writes from Spokane under date of the 14th inst.:

To the Editors AMERICAN GAS LIGHT JOURNAL: As you do not receive a superabundance of news from this part of the "wild and woolly West," I enclose a circular which I am mailing to every storekeeper and householder in the city. When you consider the fact that we pay $3 per ton freight on coal, I venture to say that the new schedule of rates makes our gas as cheap, if not cheaper, than any city west of Chicago. The old rate was $2.50 per 1,000 cubic feet, with 10 per cent. discount, if paid before the 10th. We have 1,250 consumers, of which number 586 use gas stoves. In two years the Company's business has increased 100 per cent.; and this, too, in spite of the fact that electric light is cheaper here than in any other State of the Union. As an illustration: The city pays $4 per month for arcs of 2,000-candle power, burning all night and every night. Saloons keep open all night, and pay $8 per month, with as many incandescent lights as they like thrown in. Please understand that this reduction is not given in any spirit of philanthropy; but is a plain business proposition. We anticipate that this reduction will add at least 30 per cent. to our number of consumers during the year. It has been my privilege to assist in placing the Company in its present prosperous condition, and the secret of it is: If you want business go after it, keep after it, never leave it until you get it, and when you get it go after more. Keep in close contact with your consumer, and give him proper attention. If he has a kick coming don't "kick" back. Give him a few minutes of your time, even if you cannot convince him that the gas charged has been used, and by somebody, and he will go away thinking that "that gas man isn't such a bad fellow anyway; and perhaps the girls home have been keeping their gas going all night." And you; well, you go after more business—at least that is what I do.

THE text of the circular enclosed by Secretary Aldrich is as follows:

SPOKANE FALLS GAS LIGHT COMPANY,
SPOKANE, WASH., January, 1898.

Notice of Reduction of Price of Gas.—We desire to give you notice that from January 1st, 1898, the following schedule of rates took effect: 100 to 900 cubic feet, $2.50 per 1,000, less 10 per cent., if paid before the 10th; 1,000 to 3,000 cubic feet, $2.50 per 1,000, less 20 per cent., if paid before the 10th; 3,1000 cubic feet and over, $2 per 1,000, less 20 per cent., if paid before the 10th. It is the practice in Eastern cities to allow a special rate on gas when used as fuel. It is the desire of this Company that our citizens shall enjoy a service as efficient and cheap as it is possible to give. To this end, and yet prevent the duplication of meters, we have decided to put into effect the following schedule of prices which is known as—

The Fuel and Light Rate.—100 to 900 cubic feet, $2.50 per 1,000, less 20 per cent., if paid before the 10th; 1,000 to 3,000 cubic feet, $2.50 per 1,000, less 30 per cent., if paid before the 10th; 3,100 cubic feet and

above, $2 per 1,000, less 25 per cent., if paid before the 10th. To obtain this rate, all consumers using gas both for light and fuel, and all intending consumers, must notify the Company in person or in writing, that a register may be kept of its light and fuel consumers. We would emphasize the fact that the old rates will be in force unless such notice is given the Company. If you are using a gas stove and not using gas for light, by using gas exclusively the reduced rate will make you a great saving. If you are not using gas for fuel, rent a gas cooking range from us and save labor. The light and fuel rate will enable you to do this to advantage.

The Wonderful Welsbach Gas Burner.—To enable those who desire to take advantage of our offer and change the method of lighting to gas, the price of the celebrated Welsbach burner will be reduced to $1.75 each, cash, or $2 when charged to your account. Mantles, 40 cents; chimneys, 10 cents each, or 50 cents and 15 cents respectively, if charged to your account. These extremely low rates place gas within the reach of all, thus putting it in your power to do your cooking at no greater cost and with infinitely less labor. We respectfully request that cases of inattention be promptly reported at the office of the Company. We desire to tender the expression of our appreciation of the generous patronage accorded us during the past year, by means of which our aim for cheap gas becomes an accomplished fact. We shall continue to pipe houses at cost. Estimates on application. We shall continue to supply the public with strictly lump Roslyn coal, at $5.50 per ton, delivered. One ton of coal is equal to two cords of wood.

Mr. John H. Burnham, who was Superintendent of the East Boston (Mass.) Gas Company from 1871 to 1893, died in Farmingdale, Maine, on the morning of the 16th inst. The correspondent who informed us of Mr. Burnham's death, adds: "Mr. John Burnham was a man who made friends with those whom he met. Possessed of a kindly, genial disposition, a big, generous heart, and always ready not only to sympathize but to alleviate, so far as was possible for him, the distressed; honest and upright in his dealings with his fellow men, he will be greatly missed by a very wide circle of sincere friends. He will be particularly missed by the Masonic fraternity. He was honored by his fellow townsmen by an election to the responsible position of Town Treasurer and Collector, and performed his duties in that honest, straightforward manner which was characteristic of the man. He is survived by a widow, two sisters and a brother, and the sincere sympathies of the community are theirs. It was his request that Maine Commandery and Hermon Lodge, F. and A. M., attend the funeral, which was held at 2 P.M., Tuesday afternoon, the 18th inst., under the direction of the named bodies. Truly, a good man has left us."

At the annual meeting of the Norwich (Conn.) Gas and Electric Company the officers chosen were: Directors, Edward N. Gibbs, New York city; George E. Terry and A. M. Young, Waterbury, Conn.; Morris F. Tyler, New Haven, Conn.; Garret A. Hobart, Newark, N.J.; and H. H. Osgood and William C. Mowry, of Norwich, Conn.; President, Edward N. Gibbs; Vice-President, Geo. E. Terry; Treasurer, Morris E. Tyler; Secretary, A. M. Young.

It is quite likely that in the rearrangement of the properties and possessions of the Binghamton (N. Y.) Gas and Electric Company a well known New York city gas syndicate will be found in control.

The Peoples Gas Light Company, of Rutland, Vt., has reduced its selling rate to $2.50 per 1,000 cubic feet. The prior rate was $3.

At a recent meeting of the Directors of the Ipswich (Mass.) Gas Company it was voted to give each consumer a rebate on the gas bills for quantities used in December, thus making the reduced rate take effect that month, instead of this, as was originally proposed.

The New Bedford (Mass.) Gas and Edison Light Company at last has sensibly decided to increase its storage accommodations. As we understand it, the Company has bargained for a holder equal to retaining 1,000,000 cubic feet. The holder is to have three lifts. Verily, New Bedford feels its growth.

The American Gas Company has succeeded to the proprietorship of the Westchester Gas and Electric Company, of Rye and Port Chester, N. Y. This Company was formerly known as the Consolidated Gas and Electric Light Company, of Port Chester, and was originally exploited by the late firm of Stanton & Coffin, of this city. Under the terms of the purchase the American Gas Company has added another money maker to its productive strings in New York.

Mr. W. H. Hayden and his associates have secured an extremely valuable concession for the future supply of gas in the City of Mexico. There is little doubt that a well known firm of American builders of gas works will carry on to completion the preliminaries so well arranged by the clever Boston interests that had sight sufficient to see the chance so far in advance.

At the annual meeting of the Charlestown (Mass.) Gas and Electric Company, the Directors chosen were: James F. Hunnewell, Jas. A. Sawtell, Charles F. Byam, John Turner, Charles R. Lawrence, Chas. F. Fairbanks and Q. A. Vinal; President, James F. Hunnewell; Clerk and Treasurer, Geo. B. Neal.

Mr. Walter F. Norton has been appointed Superintendent of the Nashua (N. H.) Light, Heat and Power Company, vice his brother, the late Mr. Fred W. Norton. The selection does credit to the owners of the Company.

"A. S." is informed that the next dividend of the Cambridge (Mass.) Gas Light Company is payable to-morrow. The amount of the dividend is $5 per share.

At the annual meeting of the Capital Gas Company, of Sacramento, Cal., the officers chosen were: Directors, B. U. Steinmann, J. B. Crockett, H. H. Taylor, Oliver Eldridge, C. H. Cummings, Frank Miller and Benj. Welch; President, B. U. Steinmann; Vice-President, Oliver Eldridge; Secretary, C. H. Cummings.

The formal annual meeting of the old San Francisco Gas Light Company resulted in the following selection of officers: Directors, Levi Strauss, A. H. Payson, Daniel Murphy, J. B. Crockett and Adam Grant; President, J. B. Crockett; Vice-President, Adam Grant; Secretary, William H. Barrett.

At the annual meeting of the shareholders in the Hackensack (N.J.) Gas and Electric Company, the officers named were: Directors, G. W. Conklin, Frank B. Poor, E. A. Pearce, W. M. Johnson, Lemuel Lozier, David St. John and Jacob Bauer; President, F. B. Poor; Vice-President, E. A. Pearce; Secretary, L. Lozier; Treasurer, W. C. Thomas.

An odd accident occurred early this month whereby Bakersfield, Cal., which depends largely on electricity for its lighting, was put for a time in darkness. Our correspondent says that "a boulder, dropping from an overhanging cliff, smashed the flume of the Power Development Company, the turbines of which actuate the dynamos that occasionally, through the good offices of the Kern river, afford some sort of light from incandescent electric lamps in Bakersfield." The Gas Company, as is usual in such instances, creditably filled the dreary lighting intermission.

Mr. Thomas P. Kingsford has been named to succeed the late Mr. H. D. McCaffrey on the Directorate of the Oswego (N. Y.) Gas Company.

Mr. William Richardson, who was named to test and report upon the quality of the gas supplied in Mount Vernon, N. Y., the testing having been carried out at the instigation of the city authorities, reported in detail, submitting a quantitative analysis result. His final conclusions were that, "From the testing and analysis, the gas, as supplied at present to the city of Mount Vernon, fully complies with the requisition of the contract."

A feature of the January meeting of the Civil Engineers' Club, of Cleveland, O., was a lecture, by Mr. M. S. Greenough, of the Cleveland Gas Light and Coke Company, on the subject of "The Construction of Modern Gas Engines."

The gain in business shown by the Western Gas Company, of Milwaukee, Wis., is simply phenomenal.

The proprietors of the Northampton (Mass.) Gas Light Company have under consideration an important scheme of plant betterment.

At the annual meeting of the Lynchburg (Va.) Gas Company, the Directors elected were: R. W. Crenshaw, W. V. Wilson, Jr., J. T. Coleman, George L. Fleming, Jas. T. Williams and R. I. Owen.

The Kalamazoo (Mich.) Gas Company has elected these officers: Directors, I. A. Ransom, E. Woodbury, J. J. Knight, C. A. Peck and J. W. Thompson; President, Ira A. Ransom; Secretary, E. Woodbury.

The Cleveland (O.) Gas Light and Coke Company will, in 1898, be managed by these officers: Directors, M. S. Greenough, J. H. Morley, D. P. Eells, F. A. Sterling, W. J. Hayes, David Sinton and J. H. Beardslee; President, M. S. Greenough; Vice-President, J. H. Morley; Secretary and Treasurer, C. H. Beardslee.

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MONDAY, JANUARY 31, 1898.

Electric Lighting and Gas.

An editorial writer in the *Electrical World* says:

The increasing use of Welsbach and other incandescent gas burners has been a source of some anxiety to electric lighting companies who have found that, notwithstanding the many points of superiority possessed by the incandescent lamp, it is being displaced to a considerable extent in some quarters by the mantled gas jet. Inferior as it is in cleanliness, color, coolness and other desirable qualities, the new gas light is so cheap, and is apparently so much cheaper than it really is, that it is making inroads of no small magnitude into the business of central stations. And it has come to stay. There can be no denial of this, because the incandescent burner is a remarkably meritorious and valuable invention. It increases the luminous efficiency of gas anywhere from five to seven times, and this at a comparatively small cost. While it has numerous and obvious defects it possesses the great and shining merit of cheapness, and hence its use.

The operation of these burners depends upon the substitution for the carbon particles precipitated from the decomposing compounds constituting ordinary illuminating gas, of a filmy "mantle" or bag of threads of certain oxides of rare metals, zirconium, thorium, cerium, etc. These substances possess the property of radiating a great proportion of the energy emitted by them when they are heated as light waves. Carbon heated to the same temperature would give out a greater proportion of heat and less of light. This substitution, aided by the fact that in the mantled burner air is admitted and the gas burned at a higher temperature than when issuing as a luminous flame from the ordinary fish-tail burner, makes a difference of as much as five to seven times in the amount of light obtainable from a given quantity of gas.

Electric current cannot be supplied at prices much below those now obtaining unless some radical and hitherto unthought of improvement in steam engines is made or the secret of its direct generation from fuel energy discovered. In order to reduce the price of electric light the efficiency of the lamp must be bettered, there being much room for this improvement.

It seems unfortunate that carbon, the only available material that will stand the temperature necessary for incandescent lamp filaments, should have a very low light emitting power—indeed the lowest. Why should not a lesson be learned from the enterprising makers of the new gas lamps? There seems to be no reason why a filament should not be coated with zirconia, or why this material may not be incorporated with the carbon-forming compound of which the filament is made. It would certainly enormously increase the efficiency of the lamp.

While the electric light is amply able to hold its own in most quarters, there is little doubt that there will be always a large field in which the chief quality sought in an illuminant will be a low price. It is also true that if the price of incandescent lighting could be reduced, leaving the station the same percentage of profit, the increase in the quantity of business would pay handsomely. There is thus every incentive for the production of some form of lamp of much higher efficiency than those now in use. The suggestion contained in the last paragraph is made simply for what it is worth—because it looks as is if this is a direction in which experiment might be productive.

The Market for Gas Securities.

The market for city gas shares was quite buoyant during the week, the leader in point of strength having been Consolidated, which advanced to 195½, later on going back to 190⅛, and at noon to-day (Friday) is at 192½. The trading in it was on a large scale, and those behind the movement evidently are not prepared just now to let the shares get beyond 195, if they can prevent it. We have no hesitancy in advising the purchase of the shares for investment or speculative account. The annual meeting for the election of Directors in the Consolidated Company was held last Monday, with the result that the following gentlemen were chosen: H. E. Gawtry, T. K. Lees, Samuel Sloan, John T. Huggins, William Rockefeller, R. S. Rolston, M. Taylor Pyne, Geo. F. Baker, James Stillman, H. D. Auchincloss, F. Augustus Schermerhorn and Edwin R. Holdin. It is said that no other business was transacted. The organization meeting will be held to-day (Friday), and the committeemen named thereat will likely have business of importance to transact, the details of which will not be communicated to the ordinary shareholder. Other city gas shares joined in the advance, East River common going to 82 bid, Standard common to 148 bid, and Mutual to 307 bid. Equitable is 225 to 235.

Brooklyn Union, on the strength of increased earnings, is in good demand at 124 to 125, and Peoples, of Chicago, is 97⅝ to 97¾, plus the regular quarterly dividend of 1¼ per cent., declared this week. Consolidated, of Baltimore, sold off sharply, from 58 to 53½, on the introduction of a bill in the Legislature to reduce the selling rate for gas in Baltimore to 90 cents per 1,000. While there is no likelihood that the bill will pass, the temporary effect on the stock is important. Bay State is "dull and regular," and 70 is bid for shares in the Richmond County (N. Y.) Gas Company. Laclede's are active and lower, and the probability is that the decision in its case before the Supreme Court will be handed down before long.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

JANUARY 31.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$36,220,000	100	191	192
Central	500,000	50		..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	225	235
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	305	315
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	.
Northern	150,000	50	..	
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	81½	..
Preferred	2,000,000	100	112	115
Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	105	106¼
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	145	150
Preferred	5,000,000	100	162	162½
Bonds, 1st Mortgage, 5's	1,500,000	1,000	114	115
Yonkers	299,650	50	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	124	125
" " Bonds (5's)	15 000,000	1,000	114	114½
Bay State	50,000,000	50	4	4¼
" Income Bonds	2,000,000	1,000	..	75
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	93½	97
3d " " "	3,000,000	1,000	..	88
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Company	25,000,000	100	97¼	97⅜
Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,000,000	.	89	90
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	77	..
" Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	206	207½
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	53⅝	58¾
Mortgage, 6's	3,000,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit	4,000,000		55	57
" Con. Bonds	4,812,000	..	97	97½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	81	93
" Bonds	2,000,000	..	93	95
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	118	125
" Bonds, 6's	2 650,000	..	107	109
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	88	88
Bonds	1,000,000	1,000	92	94
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	46	46½
Preferred	2,500,000	100	93	95
Bonds	9,084,400	1,000	105	105¼
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x

New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53¾	54
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	97⅜	97½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10,000,000	100	94	94½
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage 6's	650,000	..	84	87
Extension, 6's	800,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	2,500,000	25	18½	20
Bonds	1,000 000		94	97
Washington, D. C	2,000,000	20	250	
Western, Milwaukee	4,000,000	100	82	85
Bonds, 5's	3,556,000		102	103
Wilmington, Del.	550,000	50	200	

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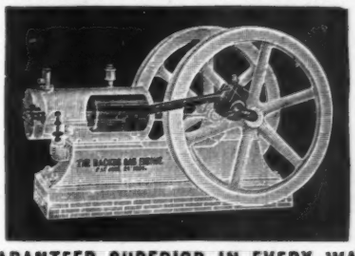

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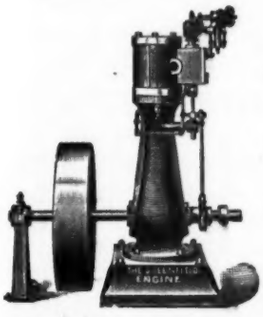

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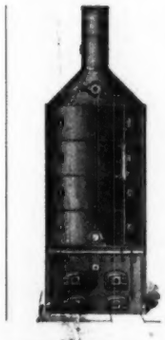

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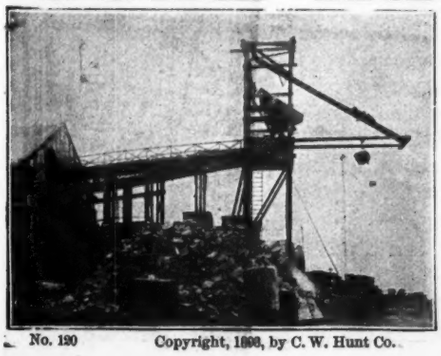

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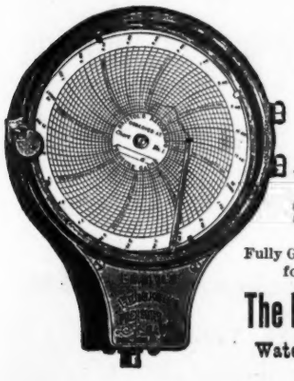

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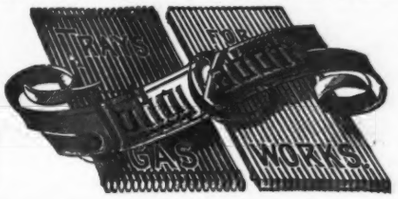

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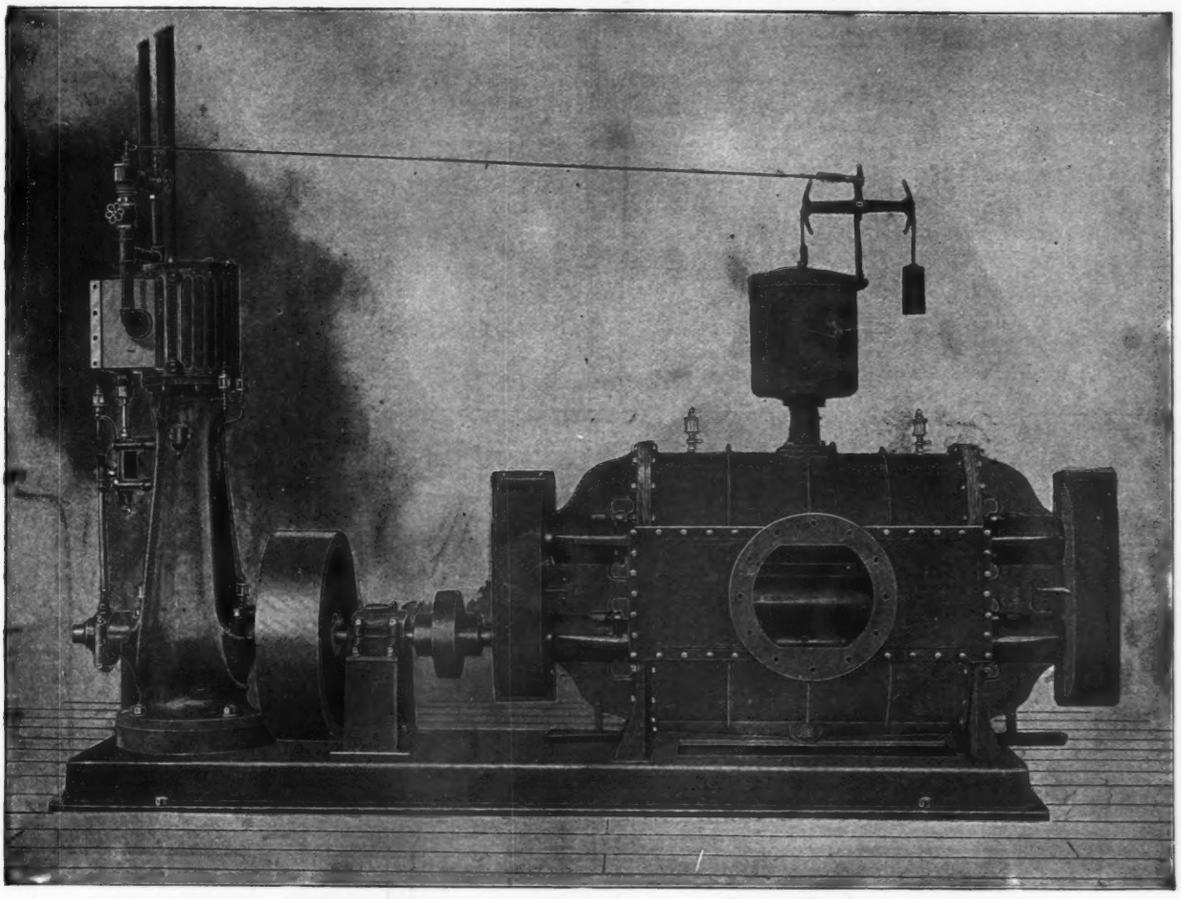

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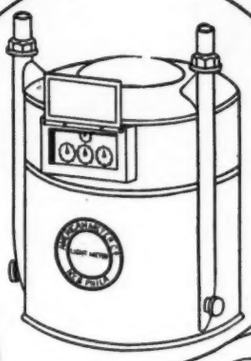

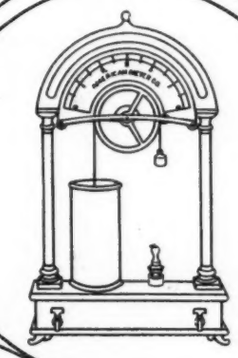

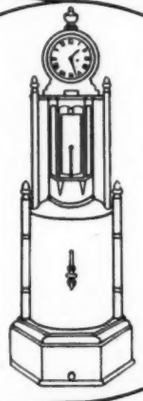

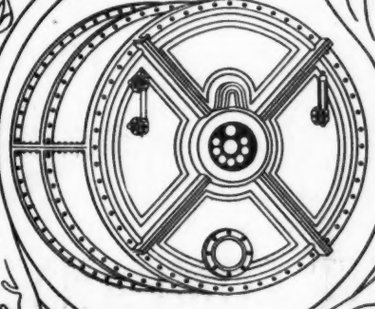

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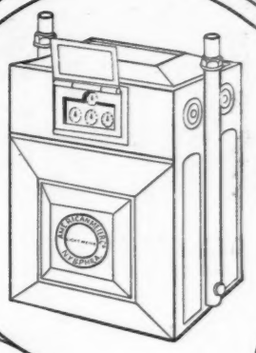

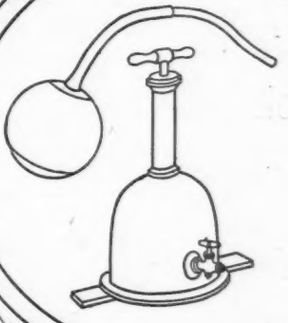

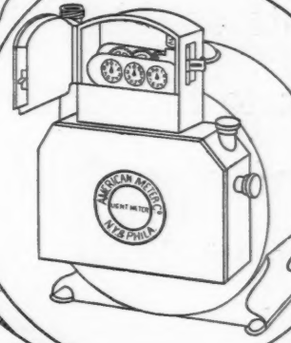

PUBLIC LIGHTING TABLE.

FEBRUARY, 1898.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	3.20 AM	6.10 AM	5.05	6.15
Wed.	2	4.10	6.10	5.05	6.15
Thu.	3	4.50	6.10	5.05	6.15
Fri.	4	5.20	6.10	5.05	6.15
Sat.	5	No L.	No L.	5.10	6 10
Sun.	6	No L. FM	No L.	5.10	6.10
Mon.	7	No L.	No L.	5.10	6.10
Tue.	8	6.00 PM	8.40 PM	5.10	6.10
Wed.	9	6.00	9.50	5.10	6.10
Thu.	10	6.00	11.00	5.10	6.10
Fri.	11	6.00	12.10 AM	5.10	6.10
Sat.	12	6.00	1.20	5.20	5.55
Sun.	13	6.10 LQ	2.30	5.20	5.55
Mon.	14	6.10	3.40	5.20	5.55
Tue.	15	6.10	4.40	5.20	5.55
Wed.	16	6.10	5.40	5.20	5.55
Thu.	17	6.10	5.50	5.20	5.55
Fri.	18	6.10	5.50	5.20	5.55
Sat.	19	6.10	5.50	5.30	5.55
Sun.	20	6.20 NM	5.40	5.30	5.55
Mon.	21	6.20	5.40	5.30	5.55
Tue.	22	6.20	5.40	5.30	5.55
Wed.	23	6.20	5.40	5.30	5.55
Thu.	24	6.20	5.40	5.30	5.55
Fri.	25	10.20	5.40	5.30	5.55
Sat.	26	11.20	5.40	5.30	5.45
Sun.	27	12.20 AM FQ	5.30	5.30	5.45
Mon.	28	1.10	5.30	5.30	5.45

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

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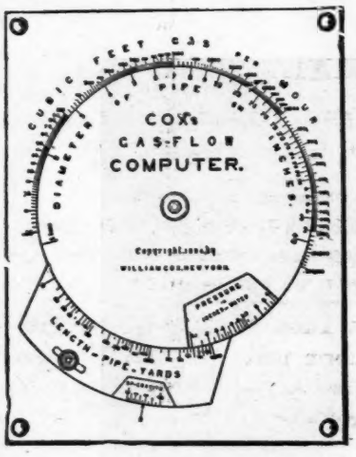

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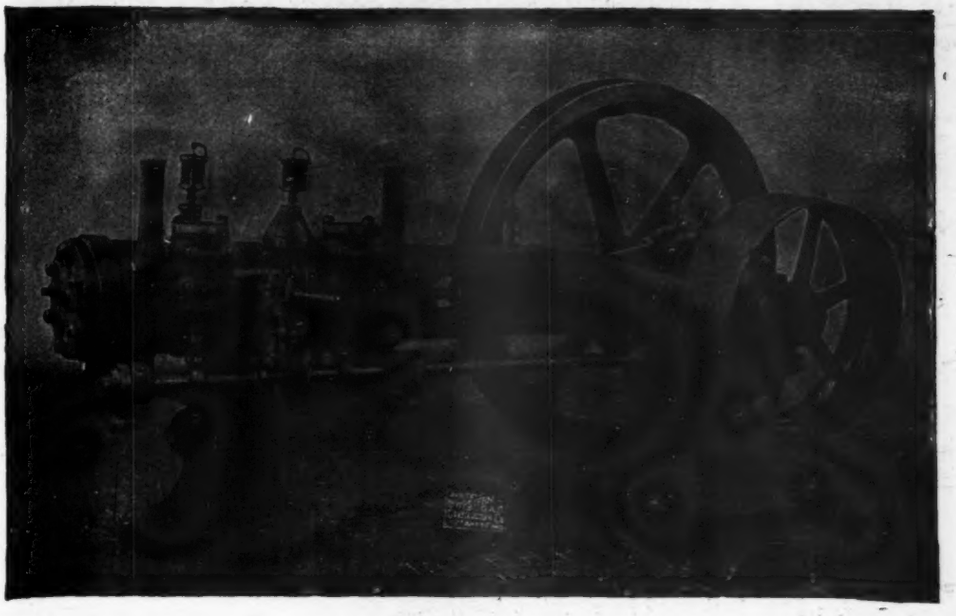

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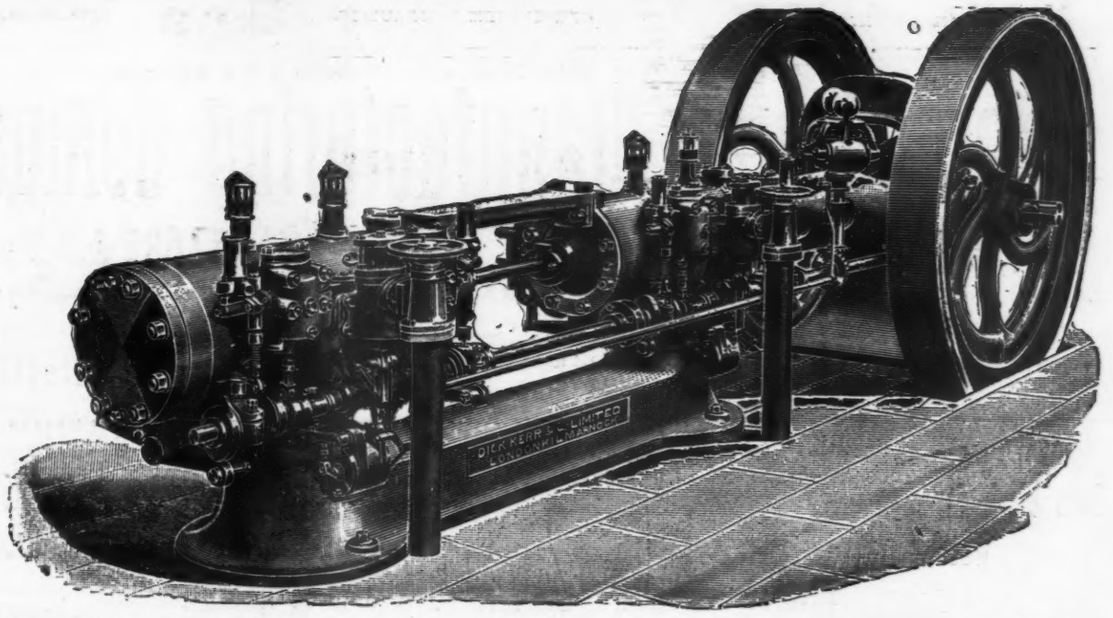

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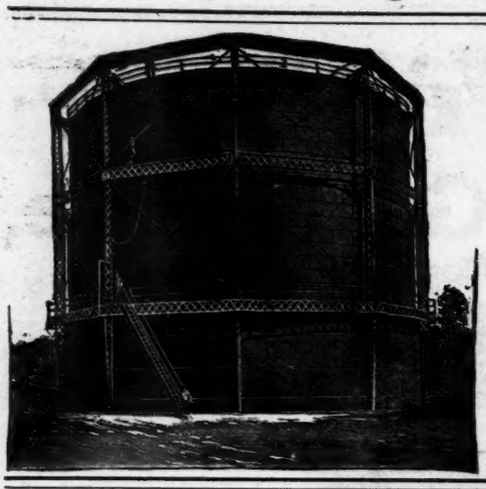

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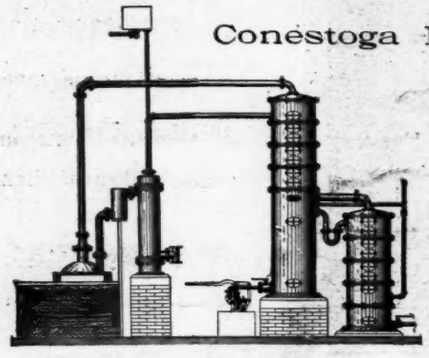

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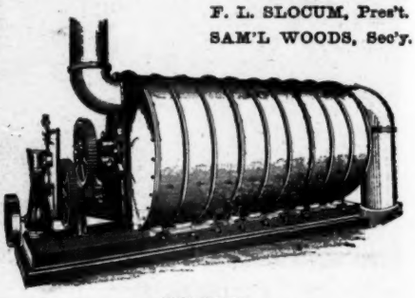

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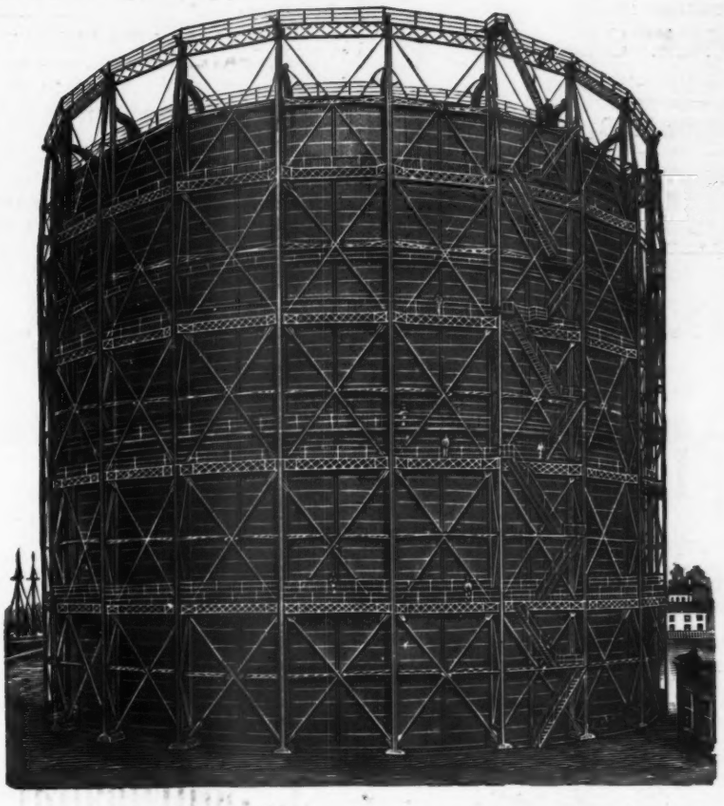

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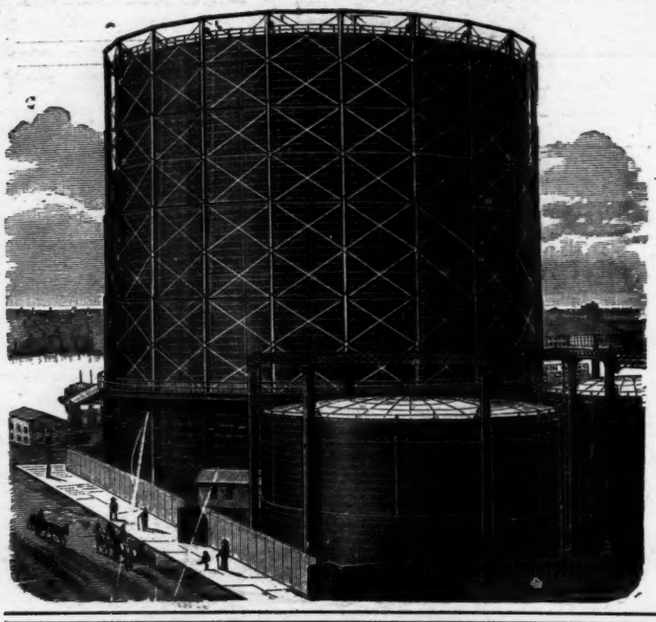

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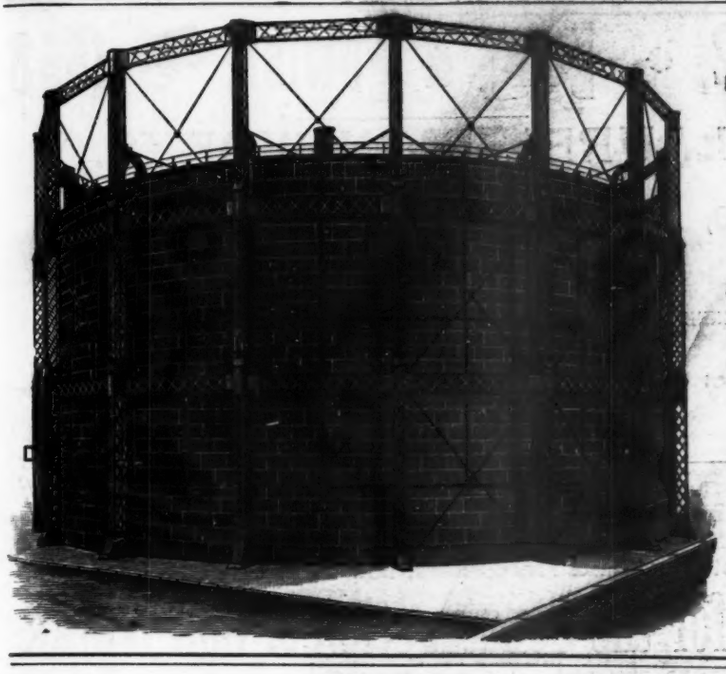

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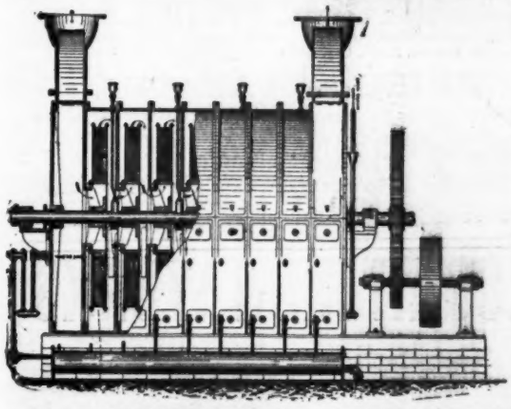

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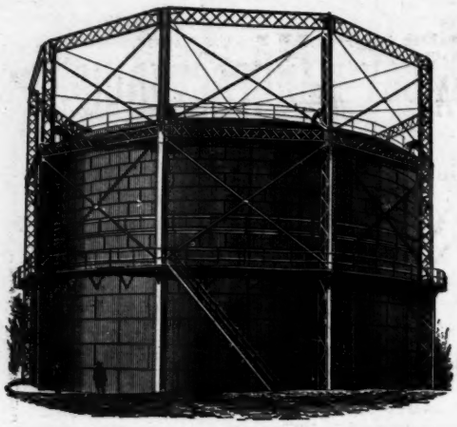

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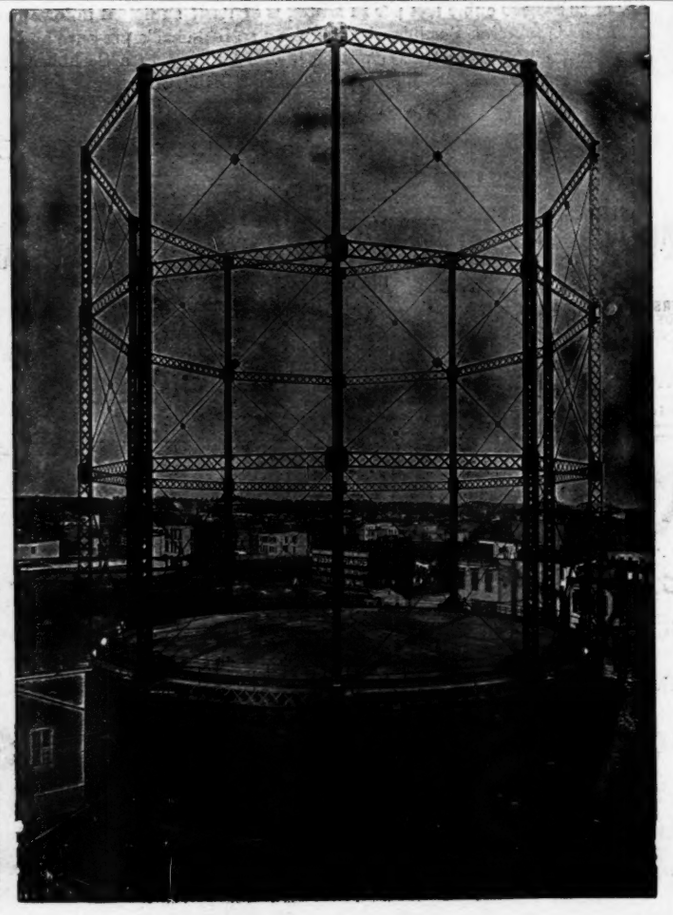

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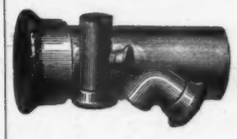
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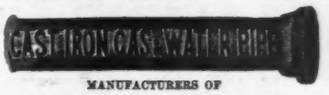

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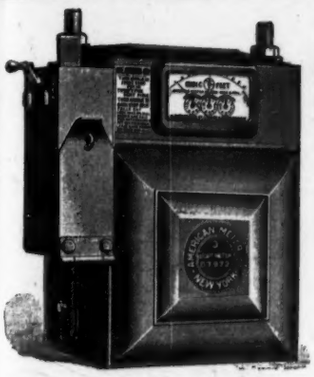

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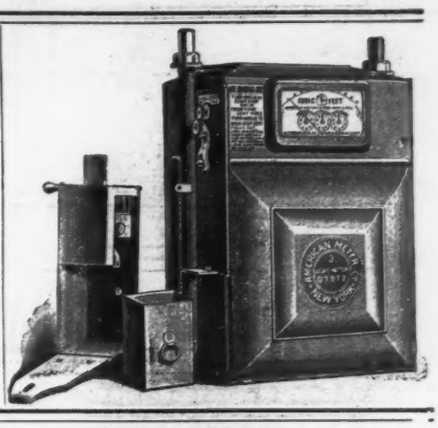

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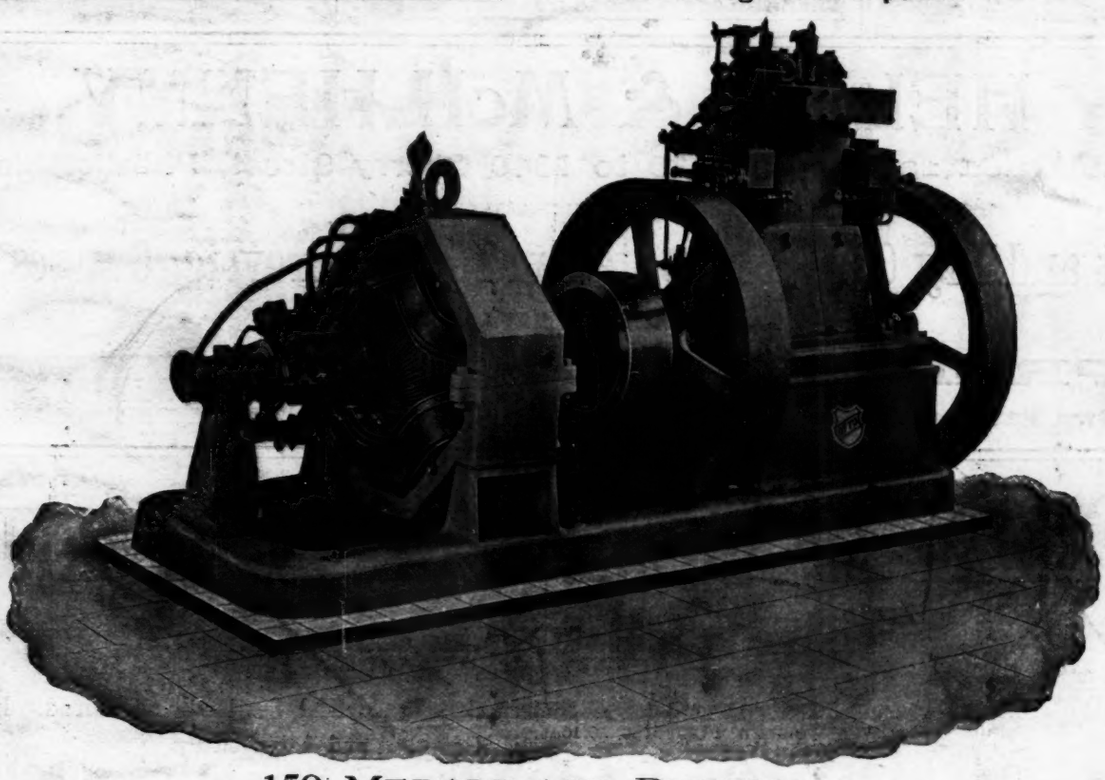

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DEMONSTRATION

It is almost a quarter of a century since the "Otto" revolutionized old and bad practices by introducing principles of combustion "entirely new" in the construction of Gas Motors.

A quarter of a century of uninterrupted success has demonstrated the correctness of these principles.

The gas engine history of the past proves that all competitors have recognized this fact by becoming imitators.

Since its advent the "Otto" engine has been illustrating mechanical improvement without alteration, while others have been offering alterations as improvements.

The experience of the past shows that it requires years to determine the real merits of a gas engine, and that nearly all new gas engines prove failures. **The fittest survive, and the only safe thing to do** in selecting a gas engine is to buy what the tests of practical use, through a long period of time, have proven to be the best.

The Practical Tests of a Quarter of a Century have Demonstrated that the "OTTO" Stands To-day Unrivaled

For simplicity of construction and grace in design; for general reliability and ease of management; for quiet and smooth running qualities; for efficiency and low gas consumption; for regularity of speed and close regulation of power.

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